ABSTRACT

The Differential Role of Impulsivity, Neuroticism, and Negative Affect Within and Across Scores on Measures of Behavioral Addiction and Substance Abuse

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Behavioral addictions (BAs) are generally characterized as excessive behaviors (not involving psychoactive substance use) that produce short-term rewards and persist despite adverse consequences or attempts to control them. The study of behavioral addictions is timely as many of these disorders are under consideration for inclusion in the upcoming *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition* (DSM-5). These behaviors include gambling, shopping, exercise, work, sex, Internet use, video gaming, and binge eating. Evidence suggests the phenomenology and development of BAs often overlaps with substance addictions. In terms of personality, impulsivity, neuroticism, and negative affect are strongly associated with substance addictions. Limited available evidence suggests these traits may also influence the development and maintenance of behavioral addictions. This study examined these three factors within and across eight theorized BAs and substance abuse. Three-hundred-thirty-four University students and 255 online participants completed a wide range of self-report instruments measuring BAs, substance use, impulsivity, neuroticism, and negative affect. Results showed impulsivity was positively correlated with every addictive behavior and

substance abuse except work and exercise, which were negatively related. Additionally, there were significant differences between samples when examining the roles of neuroticism and negative affect. The older, more pathological sample registered stronger correlations, suggesting neuroticism and negative affect may be more predictive of addictive patterns later in life or in those with greater levels of co-morbid mental illness. As a result, BAs may be conceptualized as lying at the two poles of a continuum of inhibitory control, despite similar phenomenology and functional impairments. This study suggests the end stages of BAs may look similar, although particular BAs, such as work and exercise addictions, may have different initial motivators or reinforcement mechanisms.

The Differential Role of Impulsivity, Neuroticism, and Negative Affect Within and Across Scores on Measures of Behavioral Addiction and Substance Abuse

by

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CHAPTER ONE

Introduction

"Behavioral addictions" (BA) are defined as excessive and persistent reward-seeking behaviors that do not involve the consumption of a substance. These include behaviors such as gambling, shopping, exercise, work, sex, Internet use, gaming, and binge eating (Albrecht, Kirschner, & Grüsser, 2007). These behaviors are carried out despite awareness of adverse consequences and functional impairment (Grant, Potenza, Weinstein, & Gorelick, 2010). Currently, there is no unitary construct for diagnosing behavioral addictions. Not surprisingly, there is an ongoing debate regarding which behaviors merit inclusion in the upcoming *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition* (DSM-5) and in which diagnostic category these disorders best fit (Grant, Potenza, Weinstein, & Gorelick, 2010).

Frequently, BAs have been considered diagnostically similar to substance addictions (Grant, Potenza, Weinstein, & Gorelick, 2010). Those disorders currently mentioned in the *Diagnostic and Statistical Manual of Mental Disorders Fourth Edition* (DSM-IV-TR), namely pathological gambling and binge eating, are classified under the categories impulse control disorders (ICDs) and eating disorders, respectively (APA, 2000). Formal criteria have been proposed for a number of other disorders characterized by excessive and problematic engagement in behaviors such as shopping (Lejoyeaux, Adès, Tassain, & Solomon, 1996), Internet use (Liu & Potenza, 2007), and sexual behavior (Garcia & Thibaut, 2010). Currently, clinically significant behaviors in these

areas would fall in the category "Impulse Control Disorders Not Elsewhere Classified" (APA, 2000).

While there is no consistent diagnostic concept or approach to treatment with these disorders, their clinical importance is increasingly apparent in light of high rates of comorbidity for these addictions with substance use, personality, and affective disorders (Albrecht, Kirschner, & Grüsser, 2007). The need for a clear conceptualization and improved etiological understanding of these disorders is additionally evident as BAs are currently under discussion in developing the DSM-5 (Potenza, 2006; Potenza, Koran, & Pallanti, 2009). Given the lack of unified construct, classification system, or diagnostic criteria for the majority of the BAs listed above, it is not surprising that available research is sparse and often limited in depth and breadth.

More recently, BA researchers are turning their attention to personality factors. Theorists have defined the construct of personality in multiple ways; one set of theories focuses on personality traits. According to Watson, Clark, and Harkness (1994), personality is a complex organization of trait dispositions that are interrelated within the individual. Other trait theorists see personality as an interrelated set of dimensions composed of an individual's consistent tendency to think, feel, or act in certain ways (McCrae & Costa, 1990; Eysenck & Eysenck, 1991). Eysenck (1984) argues, "The empirical evidence overwhelmingly demonstrates that broad, general traits of personality do exist, and are associated with general and consistent forms of conduct" (p. 323). These traits could predispose one to developing psychopathology, influence symptom pictures, and/or strengthen via the experience of mental illness.

The study of trait impulsivity related to BA is a promising area for future exploration and follows the trend to classify these disorders around deficits in impulse control. Current research is limited, with most studies investigating impulsivity in pathological gambling, the only disorder that is fully recognized in current DSM-IV-TR (Bagby, 2007; Myrseth, Pallensen, Molde, Johnsen, & Lorvik, 2009). Many researchers have considered impulsivity as a multifaceted construct (Depue & Collins, 1999; Patton, Stanford, & Barratt, 1995). As a result, the concept of impulsivity has been divided into more distinct, separate traits (e.g. sensation-seeking, urgency, lack of premeditation, lack of perseverance, etc.) within multiple models of personality and impulsivity (Whiteside, Lynam, Miller, & Reynolds, 2005). No study has examined this general trait or its more specific subdivisions across a wide range of BAs simultaneously. Such research could provide valuable insight into the role of impulsivity within and among these disorders.

Understanding neuroticism and negative emotionality is also important in the study of BAs. For example, epidemiological models link addictive behaviors with the reduction of psychological tension (Dell'Osso, Altamura, Allen, Marazziti, & Hollander, 2006; Lejoyeux, McLoughlin, & Adès, 2000). These models are similar to models that partially explain the development and maintenance of substance addictions, discussed later. As such, understanding the relationship between neuroticism/negative affect and impulsivity in persons with BAs may provide insight into how these traits function within and across categories of BA. Furthermore, such data may suggest further support for the proposed common conceptualizations of BAs and substance use disorders.

This study examined relevant personality factors including impulsiveness and neuroticism/negative affect across a wide range of addictive behaviors. More

specifically, this study explored the relationship between various facets of impulsivity and neuroticism/negative affect across and within the BAs: pathological gambling, compulsive buying/shopping, exercise, work, sex, Internet use, video gaming, and binge eating. Additionally, it investigated whether these disorders display similar patterns with substance addiction, with respect to impulsivity, negative affect, and neuroticism.

Theories of Behavioral Addiction

Currently there are no universally accepted etiological, diagnostic, or treatment conceptualizations of behavioral addiction. In fact, these disorders also lack a universally accepted term; they are commonly referred to in the literature as behavioral addictions, behavioral dependences, non-substance addictions, compulsive addictions, process addictions, and impulse control disorders (Grant, Potenza, Weinstein, & Gorelick, 2010; Hollander, Berlin, & Stein, 2008; Lejoyeux, McLoughlin, & Adès, 2000). Three primary models have been presented and view the disorders as 1) existing along an impulsive-compulsive spectrum (Potenza, Koran, & Pallanti, 2009), or 2) disorders of impulse control (Hollander, Berlin, & Stein, 2008), or 3) addictive disorders similar to substance addictions (Grant, Potenza, Weinstein, & Gorelick, 2010). A widely accepted classification system for these disorders likely requires further research.

Currently, BAs are unspecified other than being in the DSM-IV-TR category of ICDs (currently including intermittent explosive disorder (IED), kleptomania, pyromania, trichotillomania, pathological gambling, and disorders not elsewhere classified), and are linked by the core symptom of impulsivity (APA, 2000). Indeed, the limited research does show individuals with BAs consistently score higher on measures of impulsivity, confirming this factor's potentially important role (Di Nicola et al., 2010; Lejoyeux,

Tassain, Solomon, & Adès, 1997; Raymond, Coleman, & Miner, 2003). However, impulsivity also underlies a number of other psychological disorders including antisocial personality disorder, borderline personality disorder, substance abuse, bipolar disorder, ADHD, and conduct disorder (Evenden, 1999; Hollander, Baker, Kahn, & Stein, 2006; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001; Tolin & Morrison, 2010). As such, impulsiveness alone is an insufficient symptom on which to base this wide range of disorders. As new and existing disorders are considered for inclusion in DSM-5, the validity of this diagnostic category is also under review (Hollander, 2006; Potenza, 2007).

Others have explored whether ICDs and BAs should be viewed along an impulsive-compulsive spectrum of disorders including obsessive-compulsive disorder (OCD) at the opposite end of the spectrum (Potenza, Koran, & Pallanti, 2009). This conceptualization is reflected in the terminology for certain disorders such as "compulsive shopping" or "compulsive gambling." However, the evidence supporting this hypothesis is mixed. Risk-avoidance has been proposed as the fulcrum of this continuum with impulsivity (reduced recognition of threat combined with excessive actions to obtain pleasure) and compulsivity (exaggerated recognition of threat paired with attempts to secure safety) at the opposite ends of the spectrum (Berlin & Hollander, 2008; Hollander & Rosen, 2000; Hollander, Baker, Kahn, & Stein, 2006). Additionally, patients with ICDs and patients with OCD often report similar clinical experiences; both identify uncontrollable behaviors as a primary concern (Grant & Potenza, 2006). However, most reason that ICDs and OCD are substantially different (Potenza, Koran, & Pallanti, 2009). For example, repetitive behaviors in ICDs are typically motivated by

ego-syntonic feelings whereas obsessions and compulsions in OCD are generally described as ego-dystonic (Stein & Lochner, 2006). In addition, those with ICDs tend to view their behavior as pleasurable, at least initially, whereas those with OCD tend to describe their compulsions as distressing but necessary, suggesting positive and negative reinforcements, respectively (Opdyke & Rothbaum, 1998; Stanley, Swann, Bowers, & Davis, 1992). In a recent review comparing OCD with pathological gambling, a stronger connection was observed between the clinical course of pathological gambling and other psychiatric disorders (e.g., substance addiction) than with OCD (Potenza, Koran, & Pallanti, 2009). Taken together, existing evidence suggests that viewing BAs through the lens of compulsivity is also insufficient.

As suggested by the term behavioral "addiction," these disorders have also been viewed within the framework of substance addictions. Both share a number of phenomenological similarities, including a shared core feature of failure to resist an impulse, temptation, or drive to engage in a behavior that causes harm to the person or others (APA, 2000). Evidence confirms the similarity of substance and behavioral addictions, as they share a similar course, symptom picture, and neurobiological underpinnings. For example, both tend to appear first in adolescence and young adulthood, and both share chronic, cyclic patterns; furthermore, many people recover without formal treatment (Chambers & Potenza, 2003; Slutske, 2006). Additionally, those with BA report an urge or craving in response to emotional dysregulation, development of tolerance, symptoms of psychological and physical withdrawal, and a perceived loss of control over the undesirable behavior, all of which are characteristic of substance addiction (Albrecht, Kirschner, & Grüsser, 2007; de Castro, Fong, Rosenthal,

& Tavares, 2007). But unlike OCD, both behavioral and substance addictions are generally considered ego-syntonic at first, often shifting to a more ego-dystonic state over time. This occurs as the behavior (or use of a substance) shifts from being pleasurable and positively reinforcing to feeling more compulsive or motivated by negative reinforcers such as avoiding depressed mood or withdrawal symptoms (Brewer & Potenza, 2008; Potenza, Koran, & Pallanti, 2009).

Griffiths (2005) proposed a more comprehensive components model of addiction, including substance and behavioral addictions. He proposed that each is composed of the factors: 1) salience (when the activity becomes the most important part of the individuals life, dominating their thinking, feelings, and behavior); 2) mood modification (engaging in the behavior serves as a coping strategy); 3) tolerance (needing increasing amounts of the substance or activity to achieve equivalent effects); 4) withdrawal symptoms (distressing physical and/or psychological symptoms occurring when the activity or substance is reduced or discontinued); 5) conflict (interpersonal, intrapsychic, and conflicts with other activities); and 6) relapse (recurrence of the activity once abstinent). All of the behavioral addictions listed above could be represented in this model, further supporting a view of these disorders along an addictive spectrum.

Functional neuroimaging studies also suggest a neurobiological link between behavioral and substance addictions (Grant, Brewer, & Potenza, 2006). Both addictive substances and addictive behaviors may metaphorically hijack the body's natural reward systems and motivate continued exposure in those who develop addictions (Adams, 2009). Substance and behavioral addictions are also commonly comorbid with one another and other psychological disorders such as personality and affective disorders,

which is not the case with OCD (Shaffer et al., 2004; Tavares & Gentil, 2007). The adverse consequences of both substance and behavioral addictions are similar and include the commission of illegal acts to maintain the behavior or substance use, and financial and marital problems (Ledgerwood, Weinstock, Morasco, & Petry, 2007). Finally, both tend to respond positively to the same psychosocial and pharmacological treatments (Grant, Potenza, Weinstein, & Gorelick, 2010). Clearly, there is a strong basis for viewing BAs within the context of a larger conceptualization of addictive disorders, however the discussion remains open.

Behavioral Addictions of Interest

I examined the following eight BAs: pathological gambling (PG), compulsive buying/shopping (CB), exercise addiction (EA), work addiction (WA), sex addiction (SA), Internet addiction (IA), video gaming addiction (GA), and binge eating disorder (BED). Basic information for each disorder including prevalence, course, symptom picture, demographic trends, and treatment is reviewed.

Pathological Gambling

Pathological gambling (PG) is characterized by the recurrent, perceived inability to resist urges to engage in gambling behavior that is maladaptive and results in functional impairment, analogous to substance abuse (APA, 2000). Commonly, those with PG report relationship, legal, and financial problems related to gambling behavior (e.g. spending the family's savings, theft to acquire money to continue the behavior, etc.). These psychosocial effects often result in a problem gambler's identification by clinicians (Hollander, Berlin, & Stein, 2008). Prevalence of pathological gambling in North

America is estimated between 1% and 3% of the adult population (Shaffer, Hall, & Vander Bilt, 1999; Stucki & Rihs-Middel, 2007). Those with PG are more likely to be male, non-White, less educated, unmarried, and have a current or past history of substance abuse (Afifi, Cox, Martens, Sareen, & Enns, 2010; Johansson, Grant, Kim, Odlaug, & Götestam, 2009; Lorains, Cowlishaw, & Thomas, 2011). Onset typically occurs in late adolescence and the course of PG tends to be progressive and chronic with either a regular or episodic pattern analogous to the onset, course, and patterns of use typical of substance abuse disorders (Hollander, Berlin, & Stein, 2008; Jiménez-Murcia et al., 2010).

Pathological gambling is likely the most thoroughly studied of the BAs and is commonly treated through a combination of pharmacological options such as antidepressants, mood stabilizers, and anti-addiction drugs (Dannon, Rosenberg, Schoenfeld, & Kotler, 2011) and psychotherapeutic treatments such as cognitive behavioral therapy and 12-step groups such as Gamblers Anonymous (Hollander, Berlin, & Stein, 2008).

Compulsive Buying/Shopping

Compulsive buying/shopping (CB) is not specifically recognized in the DSM-IV-TR. Some researchers suggest it is defined by a maladaptive preoccupation with or impulse to engage in shopping or buying that can contribute to personal distress, social, occupational, or marital dysfunction, financial, or legal problems (McElroy, 1994). Additionally, the behavior is presumed to alleviate tension, negative feelings, and anxiety. Those with CB most often have a comorbid mood, anxiety, substance abuse, eating or personality disorder (Black, 2006). The most recent estimates suggest 5-6% of

the adult population in the United States is afflicted with CB (Koran, Faber, Aboujaoude, Large, & Serpe, 2006). The disorder is thought to affect women far more than men with rates between 80-95% for those participating in clinical studies (Ditmar, 2004; Black, 2006). While research is limited, CB may be chronic or recurrent with fluctuations in severity and intensity. Onset is often paired with entering college, emancipation from the home, or upon obtaining a credit card or checking account (Black, 2006).

Compulsive buying/shopping has been treated with some success using serotonin-based antidepressants that help curb urges to shop, but relatively little controlled pharmacological research on CB exists. Many different psychotherapeutic models have been utilized and written about including psychodynamic, cognitive-behavioral, and group formats, although few (if any) treatments have been validated with CB specifically.

Exercise Addiction

Exercise addiction (EA), also referred to in the literature as exercise dependence or excessive exercise, also is not specifically recognized in DSM-IV-TR although researchers and clinicians suggest that it could fall within the category of BAs (Adams, 2009). Exercise addiction is characterized by a craving for physical activity accompanied by frequent, repeated, and stereotypical exercise that contributes to negative physical and psychological consequences (e.g. overuse injuries, tolerance, negative affect when unable to exercise, lack of perceived control over the behavior, etc.) (Adams, 2009; Hausenblas & Giacobbi Jr., 2004). Initially, based on the assumption that exercise was a positive behavior, those who fit with this conceptualization were characterized as having a "positive addiction" (Glasser, 1976). This perspective has shifted as awareness of the negative effects of excessive exercise has come to light (Hailey & Bailey, 1982; Little,

1979). Given the generally positive connotations associated with exercise, an important distinction is drawn between those who exercise healthfully and those whose relationship with physical activity may qualify as an addiction. Sachs (1981) noted differences between what he called "committed exercisers" and "addicted exercisers." Addicted exercisers were more likely to exercise for intrinsic rewards such as mood regulation, view exercise as the most central aspect of their lives, and experience a sense of deprivation and emotional distress when they were unable to exercise. These distinctions, along with other criteria analogous to substance dependence, comprise a useful set of diagnostic indicators as clinicians and researchers increasingly recognize exercise addiction as a distinct disorder.

Two recent studies of 589 and 2,853 college students recorded rates of compulsive exercise as 18.1% and 8.5%, respectively (Guidi et al., 2009; Martinotti et al., 2011). Due to the paucity of research in this area, the demographic characteristics of typical exercise addicts cannot be stated. Primary exercise dependence (behavior independent of a comorbid eating disorder) may be more likely in males while secondary exercise dependence (behavior that occurs in the context of a comorbid eating disorder) may be more prevalent in females (Zmijewski & Howard, 2003). Perhaps the strongest finding is the consistent co-occurrence of exercise addiction and psychopathology, particularly eating disorders (Bamber, Cockerill, Rodgers, & Carroll, 2000). Additionally, little is known about the typical onset, pattern, and course of exercise addiction. Some evidence using rats has suggested that intense, chronic exercise may increase the availability of important neurotransmitters in the body's natural reward

system, such as dopamine, increasing its potential to self-reinforce (Liste, Guerra, Caruncho, & Labandeira-Garcia, 1997).

Practitioners report difficulty in recognizing and diagnosing the disorder, as a result, little controlled research exists. A number of physiotherapists have attempted to treat and manage the behavior through the use of educational strategies and encouragement of alternative activities (Adams & Kirby, 1997). Additionally, motivational interviewing (MI) and cognitive behavioral therapy have been considered, although no clinical trials thus far have applied these treatments with exercise-dependent persons (Adams, 2009).

Work Addiction

The term "workaholic" was coined by Oates in 1971 and has since gained popular acceptance (Andreassen, Ursin, & Eriksen, 2007). Despite recognition that individuals may develop a relationship with work that is analogous to substance addiction, reflected in Oates' choice of terminology, there is a stark paucity of empirical research regarding those who perceive their need to work as so great that it negatively impacts their psychological, physical, and social functioning (Harpaz & Snir, 2003 Ng, Sorensen, & Feldman, 2007). In particular, researchers have debated the definition of work addiction (WA) (McMillan & O'Driscoll, 2006). Numerous researchers have proposed models in which there are various, distinct subtypes of workaholics (Naughton, 1987; Scott, Moore, & Miceli, 1997) or varying components of workaholism (Spence & Robbins, 1992). Many researchers have also retained the conceptualization of work as an addiction akin to substance addiction (Griffiths, 2005). The 12-step-based Workaholics Anonymous group suggests that work addiction is characterized by factors such as excitability regarding

work, working during time off or meal times, difficulty delegating work to others, viewing work as an escape from the reality of one's life, and working beyond the scope of the job description (Garson, 2005). Additionally, researchers debate whether workaholism should be viewed as a positive set of behaviors that increase a person's sense of life satisfaction or as a negative set that reflect an irrational and excessive cognitive, affective, and behavioral engagement in work (Harpaz & Snir, 2003). Regardless, WA is generally accepted to contribute to adverse emotional and physical health consequences (Burke, 2000; Spence & Robbins, 1992) and decreased life and relationship satisfaction (Robinson, 1998).

Little is known about the onset, course, and pattern of work addiction. A few studies, primarily outside the United States, indicate that workaholics tend to be male and that married men and unmarried women are more likely to present with symptoms of work addiction than their counterparts (Burke & Matthiesen, 2004; Harpaz & Snir, 2003). Other studies have found no such connection between workaholism and gender (Burke, 1999; Doerfler & Krammer, 1986). Not surprisingly, little is known about effective treatment for those with work addiction and the only organized treatment model at present is the 12-step-model applied to the treatment of many substance and behavioral addictions.

Sexual Addiction

Sexual addiction (SA) has been researched under a number of different monikers including sexual compulsivity and problematic hypersexuality, although it tends to be defined as a loss of control over sexual urges, fantasies, and behaviors that results in negative consequences, functional impairment, or personal distress (Gold & Hefner,

1998; Kafka, 2001). Operationally, it has been conceptualized as a pathological relationship with a mood-altering experience similar to conceptualizations of substance addiction (Seegers, 2003). Currently, SA may be diagnosed as: Paraphilia Not Otherwise Specified (NOS), Impulse Control Disorder NOS, or Sexual Disorder NOS, depending on the particular behaviors exhibited by the individual (Irons & Schneider, 1996; APA, 2000). Carnes (1991) identified ten signs of SA including:

1) A pattern of out-of-control sexual behavior
2) Adverse consequences related to sexual behavior
3) Persistence in sexual behavior despite negative consequences
4) Repeated efforts or desires to cut back or quit
5) Continual pattern of seeking self-destructive or high-risk behaviors
6) The use of sexual obsession or fantasy for coping
7) Tolerance
8) Mood swings related to sexual activity
9) Excessive time spent engaging in sexual fantasy, behavior, or spent recovering from sexual experiences
10) Neglecting social, recreational, and occupational activities in favor of sexual behavior.

While these symptoms are a clinically helpful guide, official diagnostic criteria are not yet established and may impact the validity of literature in this arena.

Carnes (1989) estimated the prevalence of SA in the United States at 3-6%. No known large-scale, controlled studies have verified this. Many of the prevalence studies for SA have been done with specific populations. For example, estimates ranging from 2-9% have been documented in college samples (Seegers, 2003) and 43.9% in a sample

of incarcerated sexual offenders (Marshall, Marshall, Moulden, & Serran, 2008). Estimates suggest 50-60% of sexual addicts are male (Ferree, 2002). Additionally, according to Carnes (2001), the course of SA is progressive and the pattern is cyclical, similar to substance addictions. Individuals tend to have a high percentage of comorbid Axis I and II disorders, including affective, anxiety, and substance use disorders as well as high rates of past sexual, physical, or emotional abuse (Black, Kehrberg, Flumerfelt, & Schlosser, 1997; Ferree, 2002; Kafka & Prentky, 1994). Neurobiologically, there is also evidence of a link between dopamine and the development of SA; many studies document the emergence of nonparaphilic and paraphilic hypersexuality in Parkinsonian patients given increasing levels of dopamine (Shapiro, Chang, Munson, Okun, & Fernandez, 2006; Solla, Floris, Tacconi, & Cannas, 2006).

Available treatments for SA still require further research for efficacy to be demonstrated, however there have been attempts to apply pharmacological (e.g. antidepressants, anti-addiction, and anti-androgen medications) and psychotherapeutic models (e.g. CBT, MI, family therapy) to the treatment of this disorder (Garcia & Thibaut, 2010).

Internet Addiction

Internet addiction (IA) is also commonly referred to as compulsive Internet use, pathological Internet use, or Internet dependency (Chou, Condron, & Belland, 2005; Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009). Internet addiction is characterized by use of the Internet that is excessive, negatively impacts functioning, and has symptoms analogous to other BAs (Chou, Condro, & Belland, 2005; Ran et al., 2010). More specifically, IA has both cognitive and behavioral symptoms including

obsessive thoughts about and preoccupation with the Internet and difficulty resisting the urge to be online (Young & de Abreu, 2011; Chou, 2001). Those with IA also report guilt about Internet use and using to escape one's problems (Caplan, 2002). There is also an increased co-occurrence of social anxiety, hostility, loneliness, and depression with IA (Caplan, 2007; Huang et al., 2010; Ju-Yu et al., 2008; Meerkerk, Van Den Eijnden, Franken, & Garretsen, 2010). Lastly, IA is associated with health (poor sleep, fatigue, poor nutrition), psychological (time distortion, sadness), social (disrupted marriages, relationship problems, social isolation), and financial problems (missed work, decreased performance) (Chou, Condron, & Belland, 2005). Additionally, some researchers have subdivided IA into five primary categories: information overload (compulsive web surfing); addictive video game playing or programming; online auction addiction; online gambling or trading addiction; and cyber-sexual relationship addiction (Young, 1998). This categorization highlights the need for differential diagnosis as use of the Internet may help enable engagement in other BAs such as PG, video gaming addiction, and sex addiction as well as a more general IA. As use of and research regarding the Internet is still in its relative infancy, further study in this area will be required to clarify diagnostic criteria.

Demographically, men are more likely than females to become Internet addicts (Brenner, 1997; Chou & Hsiao, 2000; Scherer, 1997). Much of this research has been done in Asian countries with adolescent populations who appear to be especially vulnerable (Young, 2009). As before, childhood and adolescence are typical ages for the onset of IA. One study surveying 2,620 Chinese high school students reported a prevalence rate of 2.4% (Cao and Su, 2007). Conversely, Chakraborty, Basu, & Vijaya

Kuman (2010) estimate the prevalence of IA lies between 0.3% and 38%, reflecting the vast disparity in prevalence estimates for this disorder. The prevalence rates in North America are not known. Similarly little has been studied about the typical pattern and course of IA, likely due to the heterogeneity of diagnostic criteria. In terms of treatment, a number of approaches have been suggested including cognitive behavioral therapy, motivational enhancement therapy, and abstinence-based models analogous to those employed with substance abusers (Orzack & Orzack, 1999).

Video Game Playing

While some have identified gaming addiction as a subcategory of IA, there are a number of users who play video games offline but present with similar symptoms (Salguero & Moran, 2002; Block, 2008). Regardless, the pattern of online or offline video game use mimics patterns of substance dependence and other BAs (Young, 2007). This includes excessive video game use and preoccupation with gaming, withdrawal (e.g. irritability, anger, defensiveness), tolerance, and negative consequences such as lying or hiding gaming use, loss of interest in other activities, social isolation, health neglect, academic, financial, and relationship problems, and continued use despite these consequences (Young, 2007; Block, 2008).

Most research comes from Asian countries such as Korea, Taiwan, and China, where the problem appears more acute (Young, 2007). In particular, Massive Multiplayer Online Role Playing Games (MMORPGS) are often targeted as they are characterized by nature and social elements and game length is unlimited (Lee et al., 2007; Van Rooij et al., 2011). In a recent study, 3% percent of German adolescent male students and 0.3% of female students met proposed criteria for video gaming addiction

(Rehbein, Psych, Leimann, Mediasci, & Moble, 2010). Among school-aged children in Singapore, a typical age of onset for gaming addiction, 9% reported symptoms consistent with gaming addiction (Gentile et al., 2011). Griffiths et al. (2004) reported that demographics are expanding as the average age of users, typically adolescents, is steadily increasing and greater percentages of female gaming addicts have been observed. Little is known about the course of gaming addiction (GA). Neurophysiological studies suggest that users show alternations in brain mechanisms that are similar to those found in substance abusers, although a unified understanding of this has not yet been established (Duven, Müller, & Wölfling, 2011).

Treatment options are available in a number of countries. For example, in Europe addicted individuals may seek "detox" or treatment for video game addiction (Young, 2007). Similarly, China has introduced laws that attempt to limit online gaming by regulating Internet cafes where much of this behavior occurs (Griffiths, 2008). Currently, little is known about treatment efficacy.

Binge Eating

Binge eating disorder (BED) is diagnosed under the DSM-IV-TR category "Eating Disorder Not Otherwise Specified" but is also referred to in Appendix B as a "disorder warranting further research for possible inclusion in DSM-5" (APA, 2000). Contrary to its categorization, phenomenological research has suggested that BED is more aptly characterized as a behavioral addiction, akin to substance addiction, in which the substance of abuse is (typically high-carbohydrate and fat) food (Davis & Carter, 2009; Ferriter & Ray, 2011). Striegel-Moore and Franko (2008) support its inclusion arguing that sufficient empirical evidence exists to reliably and accurately define and

diagnose BED. Proposed criteria suggest the disorder is characterized by repeated episodes of excessive food consumption characterized by certain features (e.g. rapid eating, eating in secret, eating when not hungry, eating until uncomfortably full, or feeling disgust, guilt, or depression after a binge episode) (APA, 2000; White & Grilo, 2011). These "binges" occur without the use of compensatory mechanisms (as in bulimia nervosa), and are accompanied by a sense of loss of control, distress, and functional impairment (APA, 2000; Striegel-Moore & Franko, 2008).

Prevalence is estimated at 3.5% for females and 2% for males aged 18-65 based on the World Health Organization International Diagnostic Interview (Hudson, Hiripi, Pope, & Kessler, 2007). There appears to be a more even gender and ethnicity distribution for BED than anorexia nervosa (AN) and bulimia nervosa (BN), which are typically higher in Caucasian, female populations (Striegel-Moore & Bulik, 2007; Streigel-Moore & Franko, 2008). Binge Eating Disorder is also more prevalent in overweight populations (2.9%) than the general population (1.5%), which is expected given obesity is a common consequence of BED (Devlin, 2007; Wonderlich, Gordon, Mitchell, Crosby, & Engel, 2009; Yanovski, 2003). Age of onset for BED is typically later than AN or BN. It is also more persistent and has a longer course than AN or BN with an average of 14.4 years duration (Hudson, Hiripi, Pope, & Kessler, 2007; Pope et al., 2006). BED is associated with negative health outcomes such as weight cycling, obesity-related health concerns, and increased psychiatric comborbidity (Wonderlich, Gordon, Mitchell, Crosby, & Engel, 2009). The co-occurrence of affective disorders (e.g. depression, bipolar disorder), anxiety, substance abuse, and personality disorders is most common (Wilfley et al., 2000; Wilfley, Wilson, & Agras, 2003).

Neurobiologically, research supports a positive relationship between binge eating and the use of addictive drugs, presumably due to shared activation of reward pathways in the brain (Holden, 2001; Volkow & Wise, 2005).

Cognitive behavioral therapy, interpersonal therapy, and dialectical behavior therapy (DBT) have been employed with positive results. The bulk of available evidence indicates that CBT is the treatment of choice for BED (Wilson, Grilo, & Vitousek, 2007;Telch, Agras, & Linehan, 2001; Wilfley et al., 2002). Some evidence also suggests antidepressants and anti-obesity drugs paired with anticonvulants may be efficacious treatments. (Striegel-Moore & Franko, 2008).

Comorbidity Between Behavioral and Substance Addictions

Research documents frequent comorbidity between BAs and mood, anxiety, substance use, and personality disorders (Di Nicola et al., 2010). High rates of co-occurring BAs and substance use disorders support the possibility of a shared mechanism of addiction (Sussman, Lisha, & Griffiths, 2011). Meta-analyses also document significant comorbidity among BAs themselves (Sussman et al., 2011). Similar underlying mechanisms may be driving these addictive behaviors while other factors may determine the addiction(s) expressed in an individual (Sussman et al., 2011). Carnes, Murray, & Charpentier (2005) suggest cross-tolerance may explain the frequent co-morbidities among substance and behavioral addictions. Cross-tolerance is the development of tolerance for a new addictive substance due to the development of tolerance for another substance (Khanna & Lê, 1996). For example, this effect is well documented for benzodiazepines and alcohol (Khanna & Lê, 1996). If BAs impact the same dopaminergic reward system as substances of abuse, then individuals may shift

from one addiction to another while continuing to experience reward. As such, if neural reward pathways are altered by any addiction, risk for developing additional addictions may increase (Carnes, Murray, & Charpentier, 2005; Sussman & Ames, 2008).

Sussman, Lisha, & Griffiths's (2011) meta-analysis estimates approximately 47% of the U.S. adult population meets criteria or proposed criteria for one of 11 identified addictions in a 12-month period. Substance addictions (alcohol, nicotine, illicit drugs) afflict 5-15% in the United States while BAs affect either 2-3% (BED, PG, IA, SA, and EA) or 5-15% (WA, CB). Relatively lower levels of societal restriction on behaviors such as working and shopping, as opposed to gambling and sex, may help explain prevalence differences. These researchers also recorded high co-occurrence between the BAs themselves. For example, approximately 20% of those with PG suffered from another BA, significantly higher than expected in the general population (e.g. 2-3%). Within a larger addiction spectrum, Carnes, Lisha, & Charpentier (2005) examined co-addiction with a sample of 1.604 patients in an inpatient residential treatment center for sexual disorders, including SA. They found 69% of men, 79% of women, and 80% of gay men in their sample also fit diagnostic indicators for other addictions.

Personality Factors: Impulsivity

Criteria related to impulsivity are evident in the diagnostic criteria of 18 separate disorders in the DSM-IV-TR (APA, 2000), supporting the importance of this factor in psychopathology as a whole. Impulsivity is evident in every major system of personality, although researchers frequently disagree about how it should be defined (Miller, Flory, Lynam, & Leukefeld, 2003; Whiteside & Lynam, 2001). Impulsivity research is limited by this lack of consistency. For example, some define impulsivity as a narrow trait

whereas others see it as multidimensional. The identification and definition of more specific, lower-order impulsivity dimensions is also the subject of debate (Magid & Colder, 2007; Whiteside, Lynam, Miller, & Reynolds, 2005).

Even a cursory study of major systems of personality reveals definitional differences. For example, Eysenck's & Eysenck's (1985) three-factor model (Psychoticism-Extraversion-Neuroticism) defines impulsivity across multiple personality dimensions; impulsiveness is a component of psychoticism while venturesomeness and sensation-seeking are both components of extraversion. Gray (1987) incorporated impulsivity under the umbrella of the appetitive behavioral approach system (BAS). Cloninger and colleagues placed impulsivity within dimensions of novelty seeking, reward dependence, or harm avoidance (Cloninger, Przybeck, & Švrakić, 1991; Cloninger, Przybeck, & Švrakić, 1993). Lastly, Zuckerman (1994) defined it via the sub-factors sensation-seeking and disinhibition. The measurement of impulsivity is also complex and multi-dimensional. For example, Gerbing, Ahadi, and Patton (1987) found 12 self-report and three behavioral impulsiveness components emerged from their factor analysis examining the most popular impulsivity measures at that time.

The most widely used self-report instrument for assessing impulsiveness for research and clinical applications is the Barratt Impulsiveness Scale (BIS-11: Patton, Stanford, & Barratt, 1995; Stanford et al., 2009). This measure assesses impulsivity independent of a broader personality system and is consistent with the view of impulsivity as multidimensional. The BIS-11 identifies three second-order factors: Attentional Impulsiveness (difficulty focusing attention or concentration); Motor Impulsiveness (acting without thinking); and Non-Planning Impulsiveness (behavior

involving a lack of planning or forethought). These factors combine first-order factors including: attention, cognitive instability, motor, perseverance, self-control, and cognitive complexity (Patton, Stanford, & Barratt, 1995).

Impulsivity in Behavioral Addictions

Studies of impulsivity in BAs differ widely across disorders. For example, pathological gambling, binge eating disorder, compulsive buying, internet and gaming addiction receive the most attention while work addiction, sexual addiction, and exercise addiction are lesser studied. Some suggest impulsivity may be a common trait underlying the development and maintenance of BAs. This view derives from the common comparison between BAs and substance addictions, in which researchers have consistently found elevated levels of impulsiveness (MacKillop et al., 2011). Additionally, BA diagnostic criteria and phenomenological characteristics reveal a common thread: the perceived inability to control one's urge to engage in a behavior or, in other words, difficulty resisting an impulse to act. Research with more frequently studied BAs also supports the extension of this finding to this set of disorders (Albrecht, U., Kirschner, N., & Grüsser, 2007; Grant, Potenza, Weinstein, & Gorelick, 2010). No known study has examined patterns of multifaceted impulsiveness across a wide range of BAs.

Pathological gambling represents the bulk of impulsivity and BA findings. Not surprisingly, difficulty managing an impulse to gamble is a core symptom of PG, currently diagnosed as an Impulse Control Disorder. Multiple studies found those with PG score significantly higher on measures of impulsiveness and sensation seeking (Bagby et al., 2007; Nordin & Nylander, 2007; Parke, Griffiths, & Irwing, 2004; Reid et

al., 2011). A recent meta-analysis by MacLaren, Fugelsang, Harrigan, and Dixon (2011) summarized 44 studies and found strong relationships between PG and disinhibition and (lack of) premeditation. Surprisingly, they did not find reliable correlations between PG and other aspects of impulsivity, such as low perseverance and sensation seeking. Myrseth, Pallensen, Molde, Johnson, and Lorvik (2009) compared 90 pathological gamblers with a group of non-pathological gamblers using the Neuroticism-Extraversion-Openness Personality Inventory (NEO-PI) and BIS-11. Their results showed pathological gamblers scored higher on neurotic traits associated with impulsivity. Another study used a neuropsychological Go/No-Go task in addition to the BIS-11. Compared with controls, they found those with PG committed a greater number of errors on the Go/No-go task and had higher total scores on the BIS-11. Their findings were also consistent with research suggesting PG is a heterogeneous disorder with impulsivity profiles that commonly differ on the subscale level (Fuentes, Tavares, Artes, & Gorenstein, 2006). Important to note, the majority of PG-impulsivity studies have characterized impulsivity as a unified, singular construct (Maccallum, Blaszczynski, Ladouceur, & Nower, 2007).

The literature examining CB, BED, Internet, gaming addiction and impulsivity also support elevations in this trait among addicts. For example, impulsivity correlated with binge eating using the UPPS conceptualization of impulsiveness (Fischer, Anderson, & Smith, 2004; Rush, Becker, & Curry, 2009). Nasser, Gluck, and Geliebter (2004) examined the relationship between impulsivity (BIS-11) and BED symptoms in a sample of obese women with the diagnosis. They found positive correlations between non-planning impulsivity and loss of control over a binge, motor impulsiveness and eating

when not physically hungry, and cognitive impulsivity and eating alone due to embarrassment. Researchers have also found evidence of heightened impulsivity in a sample of children in residential treatment for severe obesity (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006). This could indicate impulsivity related to binge eating may be evident as early as childhood (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006).

Research using Internet and gaming addicts also demonstrate higher levels of sensation seeking, poor self-control, and disinhibition (Kim, Namkoong, Ku, & Kim, 2008; Lin & Tsai, 2002). For example, in an online sample of 1471 Korean participants, those meeting criteria for online gaming addiction were found to score significantly lower than other online game users on measures of self-control (Kim, Namkoong, Ku, & Kim, 2008). Mehroof & Griffiths (2010) replicated this finding with 123 college student gaming addicts in the United Kingdom. Finally, a small sample (n=25) of German adults seeking treatment for IA scored significantly higher than controls on total impulsiveness (Te Wildt, Putzig, Vukicevic, & Wedegärtner, 2011).

Similar patterns exist in compulsive buyers who tend to score higher on sensation seeking and lack of effortful control. For instance, a sample of 38 patients with co-morbid CB and depression scored significantly higher than single-diagnosis depressed patents on total impulsiveness (Lejoyeux, Tassain, Solomon, & Adès, 1997). Another recent study found CB was associated with lower levels of effortful control, a negative correlate of impulsivity (Claes, Bijttebier, Mitchell, Zwaan, & Mueller, 2011).

Di Nicola and colleagues (2010) used 252 bipolar patients with at least one comorbid BA diagnosis of PG, CB, SA, IA, WA, and/or EA. They found all of the BAs,

excepting work addiction, were associated with higher total levels of impulsivity on BIS-11. Additionally, they found a trend toward significance for higher impulsiveness in those with exercise addiction.

Clearly, evidence supports a relationship between impulsivity and multiple specific BAs. However, this research is limited in size and comparability due to lack of agreement about the definition of impulsivity. Additionally, this trait has not been compared across BAs and substance addiction, suggesting need for further study.

Personality Factors: Neuroticism and Negative Affect

Negative affect (NA) and neuroticism are sometimes considered synonymous constructs and due to their high degree of conceptual overlap. However, they are distinct concepts derived from different models of personality (Watson & Clark, 1984). The term "negative affect" is derived from Watson & Clark's (1991) tripartite model. They define negative affect as a general, nonspecific factor predictive of both depression and anxiety (Watson et al., 1995). In their model, NA is the likelihood to experience negative emotionality and negative self-concept, characterized by subjective feelings of tension, nervousness, worry, anger, scorn, guilt, a sense of rejection, sadness, and elements of trait anxiety (Watson & Clark, 1984). Negative affect is considered conditional and those high in NA are believed to experience subjective distress even in the absence of a major external stressor. The term reflects a baseline negative emotional bias. For example, those high in NA would demonstrate an *enduring* sensitivity to perceived failures, disappointments, or frustrations (Watson & Clark, 1984). Negative affect is a stable, heritable, trait that is broadly related to psychopathology (Watson & Clark, 1991). As

opposed to the multifaceted construct of neuroticism, discussed next, NA is considered a unitary dimension (Watson & Clark, 1984).

Negative affect is a central factor of neuroticism; however, neuroticism is also defined by the disturbed behavior and thinking that accompanies emotional distress (McCrae & Costa, 1987). Neuroticism is a tendency to experience negative emotions *and* a tendency toward low self-esteem and emotional instability (Eysenck & Eysenck, 1975; Eysenck & Eysenck, 1991). Neuroticism is featured prominently as one of three higher-order personality factors in Eysenck & Eysenck's (1975, 1985, 1991) three-factor model of personality. It is also one of five higher-order traits in Costa & McCrae's (1992) "Big Five" or Five Factor Model of personality (FFM). Not surprisingly, neuroticism is strongly linked with NA (Watson, Wiese, Vaidya, & Tellegen, 1999). Neuroticism is also positively correlated with distress disorders (e.g. affective and anxiety disorders) and externalizing problems (Watson, Kotov, & Gamez, 2006). However, more research is needed; Kotov, Gamez, Schmidt, and Watson's (2010) meta-analysis of the big five personality traits in anxiety, depressive, and substance use disorders revealed few studies linking personality and common Axis I disorders. They note the majority of studies tend to examine the individual links between specific traits and specific disorders. Their review of 175 articles showed high levels of neuroticism defined all of the disorders examined. This finding was consistent with their argument that neuroticism always be considered when examining personality related to psychopathology.

The characterological nature of neuroticism and NA has been hypothesized to impact risk for developing psychopathology. Individuals with these temperamental traits

may be prone to more intense, frequent, and longer periods of emotional distress, leading to increased need for emotion regulation skills (Shiner & Caspi, 2003). Theory and empirical evidence support the important role of neuroticism and NA in psychopathology, although gaps in our understanding remain. The field is currently unsure how these traits impact the development of mental disorders, especially in combination with other traits like impulsivity.

Neuroticism and Negative Emotionality in Behavioral Addictions

NA and neuroticism have been identified as playing a potentially important role in the development and maintenance of the majority of the identified BAs. This is consistent with the strong association between neuroticism and the bulk of clinical disorders, discussed above. For example, a recent meta-analysis of personality in pathological gamblers found significant effects (d=.50) for negative affect (MacLaren, Fugelsang, Harrigan, & Dixon, 2011). Another study using 390 university students found neuroticism also significantly predicted symptoms of EA (Hausenblas & Giacobbi Jr., 2004). Similar findings are observed in those with BED (Barker & Galambos, 2009). This is consistent with the theory that binge eaters engage in this behavior for the purpose of regulating negative emotions (Polivy & Herman, 1999). The same is true of gaming addicts, who score significantly higher on measures of neuroticism than their non-addicted peers (Mehroof & Griffiths, 2010).

Research consistently demonstrates positive relationships between NA/neuroticism and substance addictions, further supporting their commonality with BAs (Measelle, Stice, & Springer, 2006). These findings are congruent with the etiological theory that affective instability and NA increase risk for substance addiction

(Cooper, Frone, Russell, & Mudar, 1995; Sher, 1997). Likewise, those with BAs commonly report relief of tension and negative emotionality during and after engaging in the addictive behavior. It may be the same negative reinforcement process observed in substance addiction is also active in BAs. Those with substance and behavioral addictions also report dysphoria during the withdrawal phase (APA, 2000). The removal of this dysphoria through return to the addictive substance or behavior may then strengthen this pattern (Jacobs, 1986). Commonly, clinical providers are inclined to treat all addictive disorders using similar frameworks, such as CBT or motivational models, although they are not empirically supported for most BAs. These approaches make sense theoretically. For example, clinicians often cite high levels of treatment resistance across all addictive disorders (Jacobs, 1986). Motivational models target desire, readiness, and efficacy for change related to this (Miller & Rollnick, 2002). Cognitive-behavioral approaches then teach and promote the use of coping strategies for managing the urge to relieve distress with the problem behavior.

The Intersection of Impulsivity and Neuroticism/Negative Affect

Impulsivity, neuroticism, and negative affect are strongly linked with psychopathology in general and to varying degrees in BA. However, researchers do not agree as to how these traits interact, predict, or explain the development of specific mental disorders. From a functional perspective, impulsivity could elevate risk for developing BAs if the addictive behavior functions significantly as a negative mood regulator (Grüsser, Poppelreuter, Heinz, Albrecht, & Sass, 2007). Subsequently, those high on impulsiveness may have fewer internal resources for resisting the urge to immediately relieve negative mood. The combination of impulsive, neurotic, and

negative affective traits could then increase risk for the development of substance or behavioral addictions. This conclusion follows from studies demonstrating greater levels of impulsivity, neuroticism, and negative affect in BA populations (Di Nicola et al., 2010; Watson, Kotov, & Gamez, 2006).

Very little research correlates neuroticism/negative affect with impulsivity and no studies examine all three traits within behavioral addictions. Related research in PG does show negative emotionality and impulsivity were predictive of gambling-related cognitive distortions in a sample of college gamblers (King, Abrams, Wilkinson, 2010). Additionally, a meta-analysis of personality research in PG also supports an association between a diagnosis of PG and measures of impulsivity (e.g. disinhibition, low premeditation) and negative affect (MacLaren, Fugelsang, & Harrigan, 2011). These investigators found those with PG scored significantly higher than controls on a measure of negative urgency, defined as the tendency to react rashly when emotionally distressed (Whiteside & Lynam, 2001). This data may tenuously indicate that negative affect interacts with impulsivity in pathological gamblers.

This interaction is more strongly supported in the fields of substance addiction and eating disorders. For instance, negative urgency was elevated in female samples with either BED or alcohol abuse (Fischer, Settles, Collins, Gunn, & Smith, in press; Rush, Becker, & Curry, 2009). Additionally, impulsivity moderated the association between rumination (a repetitive pattern of thinking about negative emotions) and failed attempts to quit smoking (Dvorak, Simons, & Wray, 2011). These findings support the notion that impulsivity may elevate risk for addiction or relapse when combined with negative emotionality.

Study Aims

This study aimed to examine multifaceted personality traits (impulsivity and negative affect/neuroticism) in and across eight behavioral addictions (pathological gambling, compulsive buying/shopping, exercise, work, sex, Internet use, video gaming, and binge eating). Results will help clarify the general relationship between impulsivity and negative affect/neuroticism in behavioral addictions. I also aim to study differences in this relationship across eight BAs and substance abuse. Results will also contribute to better understanding of lower-order facets of impulsivity (attentional impulsiveness, motor impulsiveness, and nonplanning impulsiveness) and provide evidence supporting the separate study of neuroticism and negative affect in BAs. This will be the first study to examine scores on measures of impulsivity, negative affect, and neuroticism across eight behavioral addictions and substance abuse simultaneously. As most BAs are not consistently defined, categorized, conceptualized, or understood, this study will help elucidate the role these traits play in and across the spectrum of addictive disorders.

Hypotheses

This study will investigate the relationship between impulsiveness, negative affect, and neuroticism in eight behavioral addictions: pathological gambling, compulsive buying/shopping, exercise, work, sex, Internet use, video gaming, and binge eating. It will also examine how these relationships may differ across BAs and substance abuse. The following hypotheses are postulated:

1) Total and subscale impulsivity scores will be positively correlated with scores on measures of behavioral addiction for each of eight behavioral addictions and substance abuse.

2) Negative affect and neuroticism scores will be positively correlated with scores on measures of behavioral addiction for each of eight behavioral addictions and substance abuse.

3) Negative affect and neuroticism scores will be positively correlated with one another due to a significant overlap in the two constructs.

4) Total and subscale impulsiveness will moderate the relationship between negative affect/neuroticism scores and scores on measures of behavioral addiction and substance use.

Exploratory Aims

This study also aims to compare the relationship between scores on measures of behavioral addiction and scores on measures of impulsivity, neuroticism, and negative affect across the eight behavioral addictions and substance abuse. Doing so, the study will explore whether impulsivity, neuroticism, and/or negative affect are more strongly related to certain behavioral addictions than others. Additionally, an exploratory factor analysis will examine the factor structure present in administering a large collection of BA measures simultaneously. This could inform the development or validation of future screening or diagnostic tools targeting a spectrum of addictive disorders concurrently.

Exploratory Hypotheses

1) The factor structure of the total combined responses to eight measures of behavioral addiction and substance abuse will produce factors with some overlap across addictions.

2) There will be a significant difference between addictions in the strength of relationships between total impulsivity scores (BIS-11 Total) and total scores on nine measures of behavioral addiction and substance use.

3) There will be a significant difference between addictions in the strength of relationships between total neuroticism scores (NEO-Neuroticism Total) and total scores on nine measures of behavioral addiction and substance use.

4) There will be a significant difference between addictions in the strength of relationships between negative affect scores (PANAS- Negative Affect Scale) and scores on nine measures of behavioral addiction and substance use.

CHAPTER TWO

Methods

Participants

The sample consisted of 343 students participating in the SONA research pool at Baylor University. Participants received research participation credit upon completion of the study. An additional sample of 255 participants was collected via Amazon Mechanical Turk (MTurk) for the purpose of sampling a wider demographic. Amazon MTurk is an online service that allows "requesters" to post "Human Intelligence Tasks" (HITS) to be completed by "workers" who come independently to the website. Amazon MTurk also allows requesters to prohibit the same user from participating more than once. For the purposes of this study, workers were restricted to United States residents and first-time participation. Participants were compensated $0.75 through Amazon MTurk for the completion of all measures. All participants were allowed to discontinue participation at any time with no negative consequence. Data gathered were completely anonymous, that is, no names or identifying information were associated with study data. Participation was not restricted by demographic factors in order to obtain the widest representation of individuals with behavioral addiction symptoms. Participants also were not excluded because of co-occurring psychopathology. High rates of comorbid psychopathology with behavioral addiction are normative and reflect the real-world presentation of these disorders (Sussman, Lisha, & Griffiths, 2011).

Procedures

Participants self-administered a set of online questionnaires via a computer of the their choosing. The study was available between November 1, 2011 and March 15, 2012. The full battery took participants approximately 1-1.5 hours to complete. Study instructions required participants to complete all questionnaires in the same, one-time sitting. Correlations and moderation models were employed to interpret the relationship between impulsivity, negative affect, neuroticism, and the eight behavioral addictions.

Measures

Neuroticism, Extraversion and Openness Personality Inventory- Revised (NEO PI-R)

The NEO PI-R (Costa & McCrae, 1992) is a valid and reliable self-report measure used to assess the five dimensions of personality identified in the Five Factor Model. The instrument contains 240 self-referent statements on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." The test measures Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Each domain contains six facets measured by eight items and is scored by converting domain and facet scores into percentiles using the norms for men and women aged 17 and older (Costa & McCrae, 1992). Facets in the Neuroticism domain include: anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability to stress. This is the primary scale of interest in this study. According to the manual, scores on the Neuroticism scale for the normative sample range from 48-240 with a mean score of 162.3 (sd= 20.1) for men and 167.2 (sd= 20.3) for women. The test manual reports test-retest reliability for Neuroticism was $r = .83$ after six years and internal consistency $\alpha = .92$. According to Costa and McCrae (1992), the NEO-PI-R has been used in over one thousand published

studies and demonstrates convergent and discriminant validity for each facet (Costa, 1996; Peidmont & Weinstein, 1994; Costa, McCrae, & Dye, 1991).

The NEO-PI-R was selected for to measure neuroticism in this study based on its wide use and acceptance as an estimate of general personality traits and neuroticism in particular. Additionally, it was chosen for its strong psychometric properties and prior use with behaviorally addicted populations (Bagby et al., 2007; Reid, Carpenter, Spackman, & Willes, 2008).

Barratt Impulsivity Scale (BIS-11)

The BIS-11 (Patton, Stanford, & Barratt, 1995) is a 30-item self-report questionnaire that assesses multiple facets of impulsivity. Respondents score each question on a 4-point Likert scale including: rarely/never, occasionally, often, and almost always/always. Total BIS-11 scores range from 30-120 with a mean total score of 62.3 (sd= 10.3). The BIS-11 measures Total impulsiveness, which is composed of three second-order traits including: Cognitive Impulsiveness, Motor Impulsiveness, and Non-Planning Impulsiveness. Each factor is comprised of two first-order factors including attention, motor, self-control, cognitive complexity, perseverance, and/or cognitive instability. The BIS-11 is widely used in research and clinical settings with greater than 550 citations using the most recent, Eleventh Revision of the BIS, further supporting its acceptance in the research community (Stanford et al., 2009). A recent review reported test-retest reliability as $r = .83$ and internal consistency as $\alpha = .83$. Additionally, Stanford et al.'s (2009) review reports strong positive correlations between similar self-report measures and nonsignificant correlations with behavioral measures of impulsiveness, supporting the instrument's convergent and divergent validity.

The BIS-11 was selected for this study for its wide acceptance and previous use in research, strong psychometric properties, and its capacity to provide a multifaceted measurement of impulsiveness.

The Positive and Negative Affect Schedule (PANAS)

The PANAS (Watson, Clark, & Tellegen, 1988) is a self-report instrument that measures the orthogonal dimensions of negative and positive affect (NA and PA, respectively). The PANAS contains two subscales, NA and PA. Respondents are asked to rate the extent to which they have felt 20 emotions (e.g. interested, hostile, guilty) on a 5-point Likert scale ranging from very slightly or not at all to extremely. Scores range from 10-50 for each subscale with a mean score of 16 (sd= 5.9) for the NA scale in a sample of 1,003 in the general population (Crawford & Henry, 2004). Instructions may be changed for any of seven possible time periods (e.g. right now, during the past week, in general), allowing the PANAS to measure NA and PA as either states or traits. The instrument is efficacious for differentiating between depression and anxiety (Brown, Barlow, & Chorpita, 1998; Jolly, Dyck, Kramer, & Wherry, 1994) and was used in a number of studies with behaviorally addicted populations (Barker & Galambos, 2009; Senol-Durak & Kurak, 2011). Test authors report internal consistency for the trait instructions (e.g. "in general") as $\alpha = .88$ for the PA scale and $\alpha = .87$ for the NA scale. The PA-NA intercorrelation is $r = -.17$. Test-retest reliability after one week is reported as $r = .68$ for the PA scale and $r = .71$ for the NA scale. Similar estimates were obtained in a more recent evaluation of the PANAS using a large, non-clinical sample (Crawford & Henry, 2004). For the scale in question, correlations with the Beck Depression Inventory (BDI) and Hopkins Symptom Checklist (HSCL) suggest good convergent

validity but not so high as to suggest interchangeability, r = .58 and .74, respectively (Watson, Clark, & Tellegen, 1988).

The PANAS was chosen for its wide use, strong psychometric properties, ability to isolate NA from PA, and prior use with BA populations.

Canadian Problem Gambling Index (CPGI)

The CPGI (Ferris, Wynne, & Single, 1999) is a 9-item self-report instrument that detects problematic gambling behavior in the general population and assists in the differential diagnosis of subtypes of problem gamblers. Individuals respond on a 4-point Likert scale (never, sometimes, most of the time, and almost always). Based on total score, individuals may be categorized by problem gambling severity (nonproblem gambler, low-risk gambler, moderate-risk gambler, and problem gambler). Scores range from 0-36 and normative data for this measure is still being garnered. The CPGI assesses behavioral domains including gambling involvement, problem gambling behavior, negative effects and consequences as a result of gambling, and environmental correlates. Ferris & Wynne (2001) reported good internal consistency α= .84 as compared with the DSM-IV (APA, 2000) criteria α= .76 and the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) α= .81. Test-retest reliability is acceptable r = .78. Criterion-related validity for the CPGI is strong with r = .83 compared with both the DSM-IV and the SOGS. Brooker, Clara, & Cox (2009) replicated findings from the original study, demonstrating good construct validity. They also found positively associations with common comorbidities including suicide attempts/ideation, mania, social phobia, major depression, and alcohol abuse.

The CPGI was chosen for its short length and ease of administration. Additionally, it was chosen for its strong reliability in detecting problem gambling behavior in a general population, as opposed to a clinical population. Also, it is useful as a measure of problem severity and is a more valid measure of the construct than other similar measures.

Compulsive Buying Scale (CBS)

The Compulsive Buying Scale (Edwards, 1993) is a 13-item self-report clinical screener for compulsive buying behavior. Respondents rate how accurately self-referential statements describe them on a 5-point Likert scale. Scores range from 13-65, although mean total scores for the normative sample could not be located. The CBS is composed of five factors including: tendency to spend, compulsion/drive to spend, feelings about shopping and spending, dysfunctional spending, and post-purchase guilty. Internal consistency is reported as $\alpha = .91$ for the full scale and ranges from $\alpha = .76 - .91$ for the five factors. One study using the CBS argues the scale can differentiate between individuals at different stages of the compulsive buying process (Desarbo & Edwards, 1996). Manolis & Roberts (2008) compared and contrasted Edwards's (1993) scale with the Faber & O'Guinn Compulsive Buying Scale (1992) and reported the two measures were significantly correlated, $r = 0.59$, but they measure different variants of the construct of compulsive buying. They note the CBS is more strongly correlated with materialism, suggesting it is better at identifying compulsive buyers driven by materialism, coping, isolation, denial, and impulsiveness.

The CBS was chosen for its ability to identify compulsive buyers who may spend for coping reasons. While used less frequently in the literature than the Faber & O'Guinn (1992) scale (Manolis & Roberts, 2008), its reliability and validity is evident.

Exercise Addiction Inventory- Short Form (EAI)

The Exercise Addiction Inventory (EAI: Terry, Szabo, & Griffiths, 2004) is a brief screening measure based on Griffiths's (1996) operational definition of BA applied to exercise addiction. This self-report instrument is composed of 6-items designed to discriminate between individuals who are at-risk, have some symptoms, or have no symptoms of exercise addiction. Respondents use a 5-point Likert scale ranging from "strongly disagree" to "strongly agree," indicating the strength of their agreement on each self-referential statement. Score range from 6-30 with a mean item score of 2.7 (sd= 0.49), lying between "disagree" and "neither agree or disagree." This may reflect the relatively low base rate for the normative sample. The EAI was cross-validated against the Obligatory Exercise Scale (Thompson & Pasman, 1991) and the Exercise Dependence Scale (Hausenblas & Symons Downs, 2001) which are lengthier but conceptually similar measures. Internal consistency is reported as $\alpha = .84$. Convergent validity is evident in its strong correlations with both the Obligatory Exercise Questionnaire and the Exercise Dependence Scale, $r = 0.80$ and $r = 0.81$, respectively. A follow-up study reported strong test-retest reliability $r = .85$ (Griffiths, Szabo, & Terry, 2005). Construct validity was demonstrated by the scale's ability to discriminate between higher and lower frequencies of exercise, similar to the comparison measures.

The EAI was chosen for its short length, ease of administration, capacity for assessing EA symptom severity, and strong psychometric properties.

Dutch Work Addiction Scale (DUWAS)

The DUWAS (Schaufeli, Taris, & Bakker, 2006) is a 17-item self-report instrument designed to assess work addiction. Respondents rate themselves on a 4-point Likert scale (almost never, sometimes, often, almost always) for each self-referential statement. Scores range from 17-68. The measure consists of two subscales: Working Excessively and Working Compulsively and its psychometric properties have been examined in multiple studies (del Líbano, Llorens, Salanova, & Schaufeli, 2010; Schaufeli, Shimazu, & Taris, 2009). There was a mean item score of 2.2 (sd= .51) for the normative sample on the Working Excessively subscale and a mean item score of 2.08 (sd= .57) for the Working Compulsively subscale. Internal consistency is reported as α= .85, with α= .80, and α= .86 for the subscales, respectively (del Libano, Llorens, Salanova, & Schaufeli, 2010). Work addiction as measured by the DUWAS is also significantly negatively correlated with perceived health (r = -.29) and happiness (r = -.31), consistent with literature on WA and indicative of construct validity (del Libano, Llorens, Salanova, & Schaufeli, 2010). The DUWAS is composed of items from two other WA inventories, the Work Addiction Risk Test (WART; Robinson, 1999) and the Workaholism Battery (WorkBat; Spence & Robbins, 1992). These measures are lengthier but provide equally accurate identification of WA (Taris, Schaufeli, & Verhoeven, 2005).

The DUWAS was chosen for its short length, ease of administration, and strong psychometric properties.

Compulsive Internet Use Scale (CIUS)

The CIUS (Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009) is a self-report instrument that measures compulsive internet use, referred to in this study as Internet addiction. The 14-item scale was developed based on Griffiths's (1996) conceptualization of behavioral addiction and DSM-IV criteria for PG. Respondents rate their frequency of engagement in specific behaviors or thoughts on a 5-point Likert scale ranging from "never" to "very often." Scores range from 0-56. Although a mean total score could not be located, individual item mean scores range from 1.46 (sd= .87) for "using the Internet on the sly" to 3.10 (sd= 1.12) for "continuing to use the Internet despite intention to stop" in a sample of 7888 adolescents (Van der Aa, N., 2009). Test authors report internal consistency is high, $\alpha = .89$. The CIUS also is strongly correlated with the related Online Cognition Scale (OCS; Davis, Flett, & Besser, 2002), providing support for concurrent and construct validity. The CIUS is also positively correlated with time spent online ($r = 0.42$), respondents' experience of problematic Internet use ($r = 0.45$), and respondents' feeling of being addicted ($r = 0.52$).

There is a relative paucity of validation studies using IA assessments and a lack of general acceptance for any particular measure. The CIUS was chosen as a suitable measure for IA screening within a relatively lengthy battery of measures due to its brevity and psychometric strength.

Problem Video Game Playing Scale (PVP)

The PVP (Salguero & Moran, 2002) is a brief, 9-item self-report instrument designed to assess problem video game playing, referred to as GA in this study. The scale was developed theoretically based on phenomenological characteristics of video

game players as well as DSM-IV criteria for substance abuse and PG (APA, 2000). Respondents are asked to think about their experiences in the past year and answer dichotomously (yes/no) to each self-referential question. The instrument is unidimensional with an acceptable level of internal consistency (coefficient α= .69) and higher consistency (α= .79) in a more recent study measuring multiple BAs (Parker, Taylor, Eastabrook, Schell, & Wood, 2008). The PVP correlates positively with frequency and duration of play and total scores are positively correlated (r = 0.47) with the Severity of Dependence Scale (SDS; Gossop et al., 1995), a measure of drug dependence that focuses on psychological variables. Researchers also found a positive relationship between scores on the PVP and players who report they play video games too much, think they have a problem associated with video game playing, and whose parents worry they play video games too often (Parker, Taylor, Eastabrook, Schell, & Wood, 2008).

There is a paucity of well-validated instruments for the measurement of GA, largely given its infancy as a possible disorder. The PVP was chosen for its prior use in a study of multiple behavioral addictions simultaneously and for its acceptable psychometric properties.

Sexual Addiction Screening Test-Revised (SAST-R)

The SAST-R (Carnes, Green, & Carnes, 2010) is a 45-item, yes/no, self-report instrument used to assess sexual addiction. It was recently updated from its original 25-items to reflect differences in sexual orientation and gender. The original SAST (Carnes, 1989) has been used extensively in treatment facilities, criminal justice settings, and educational programs (Hueppelheuser, Crawford & George, 1997; Spickard, Swiggart,

Manley & Dodd, 2002; Weiss, 2004) but the revised version is not as well established due to its newness. The SAST-R is composed of a Core scale and several subscales including: Internet, Preoccupation, Loss of Control, Relationship Disturbance, Affect Disturbance, Heterosexual Men, Homosexual Men, and Women. Internal consistency for seven samples (e.g. college women, clergy men, inpatient men, and others) ranged from α= .77 - .92, reflecting good to strong internal reliability (Carnes, Green, & Carnes, 2010). Descriptive statistics are highly variable depending on sample characteristics. For example, means on the core items scale are 2.34 (sd= 2.88) for college women and 2.89 (sd= 3.38) for college men versus 14.23 (sd= 4.15) for inpatient men.

More extensive study of the SAST-R is needed given its newness. However, the original form's wide usage and acceptance as a measure of SA suggests it is appropriate for use in this study. It is reliable for a wide variety of populations, including college students, and its sexual orientation and gender revisions are important for accurate diagnosis.

Eating Disorders Diagnostic Scale- Binge Eating Module (EDDS)

The EDDS (Stice, Telch, & Rizvi, 2000) is a 22-item, self-report scale with diagnostic utility for anorexia nervosa, bulimia nervosa, and binge eating disorder. The 14-items from the Binge Eating Module were used for this study. Respondents answered self-referential questions either yes/no or on a 7- or 14-point Likert scale for assessing frequency of a particular behavior (e.g. how many times per week?). Full instrument reliability is α= .91, with test-retest reliability for BED specifically reported as r = .89. When compared with patients diagnosed by interview, the kappa coefficient for BED was 0.74. Sensitivity, specificity, positive predictive value, negative predictive value, and

accuracy all exceeded 0.77 (Stice, Fisher, & Martinez, 2004). Those identified using the EDDS who were also diagnosed by structured interview accounted for 99% of patients and 93% of BED patients. These results suggest strong convergent validity with a common method of identification, the diagnostic interview. Stice, Fisher, & Martinez (2004) also conducted four studies providing additional evidence of the reliability and validity of the EDDS.

The EDDS- Binge Eating Module was chosen for its strong psychometric properties demonstrated over numerous studies and its ability to identify patients with BED.

Short Inventory of Problems- Alcohol and Drugs (SIP-AD)

The SIP-AD (Hagman et al., 2009) is a 15-item measure designed to assess the adverse consequences of drug and alcohol use. This self-report questionnaire asks respondents to answer "yes" or "no" to self-referential statements regarding their experiences in the past 90 days. The SIP-AD was derived from a longer measure, the Drinker Inventory of Consequences (DrInC; Miller, Tonigan, & Longabaugh, 1995), originally designed to assess the consequences of alcohol use. As a measure of convergent validity, the SIP-AD has acceptable associations with summary indices of the most recent Addiction Severity Index (ASI-Version 6): r =.68 and r =.61 for alcohol and drugs, respectively. Additionally, the correlation between the SIP-AD and the Inventory of Drug Use Consequences (InDUC; Tonigan & Miller, 2002), a variant of the DRInC, is r =.96. The internal consistency for SIP-AD total score was α= .95. These figures suggest the SIP-AD is a solid, brief measure of substance abuse and possible substance addiction.

The SIP-AD was chosen for its brevity and ease of administration in the context of an already lengthy battery, its strong psychometric properties, and its strong associations with other measures of substance abuse and addiction.

Data Analysis

Hypotheses

1) Total and subscale impulsivity scores will be positively correlated with scores on measures of behavioral addiction for each of eight behavioral addictions and substance abuse.
   Pearson *r* correlations will be calculated for this hypothesis.

2) Negative affect and neuroticism scores will be positively correlated with scores on measures of behavioral addiction for each of eight behavioral addictions and substance abuse.

   Pearson *r* correlations will be calculated for this hypothesis.

3) Negative affect and neuroticism scores will be positively correlated with one another due to a significant overlap in the two constructs.

   A Pearson *r* correlation will be calculated for this hypothesis.

4) Total and subscale impulsiveness will moderator in the relationship between negative affect/neuroticism scores and scores on measures of behavioral addiction and substance use.

   A hierarchical multiple regression analysis will be utilized to test this hypothesis.

Exploratory Hypotheses

1) There will be a significant difference between addictions in the strength of relationships between total impulsivity scores (BIS-11 Total) and total scores on nine measures of behavioral addiction and substance use.

   A series of Hotelling-Williams tests will be used to test the equality of dependent, overlapping correlations. Only a p-value of $< .01$ was considered significant in this analysis to control for the increase in Type I error resulting from a large number of comparisons.

2) There will be a significant difference between addictions in the strength of relationships between total neuroticism scores (NEO-Neuroticism Total) and total scores on nine measures of behavioral addiction and substance use.

   A series of Hotelling-Williams tests will be used to test the equality of dependent, overlapping correlations. Only a p-value of < .01 was considered significant in this analysis to control for the increase in Type I error resulting from a large number of comparisons.

3) There will be a significant difference between addictions in the strength of relationships between negative affect scores (PANAS- Negative Affect Scale) and scores on nine measures of behavioral addiction and substance use.

   A series of Hotelling-Williams tests will be used to test the equality of dependent, overlapping correlations. Only a p-value of < .01 was considered significant in this analysis to control for the increase in Type I error resulting from a large number of comparisons.

Power Analysis

I conducted an a priori power analysis using the program G*Power 3 (http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3) to estimate the appropriate number of participants required to obtain a medium effect size (Cohen's d= 0.5). The research literature examining addictions and personality factors typically report effect sizes in the small to medium range. As such, the number of participants was selected consistent with obtaining a medium effect size. The analysis indicated 107 subjects were needed for multiple regression and 134 subjects were needed for Pearson *r* correlations.

CHAPTER THREE

Results

Sample Characteristics

Data were collected from two online sources producing two distinct data sets. In comparing the sets, evident demographic differences on characteristics that could reasonably be assumed to impact hypothesis testing (e.g., age, mental illness) were found. As a result, each sample will be presented and examined separately.

In the sample drawn from Baylor University's SONA system, there were 334 total participants including 113 males (33.8%) and 221 females (66.2%). The mean age of all the participants was 19.22 years (*SD* =. 47). There were 196 Caucasians (58.7%), 36 African Americans (10.8%), 28 Hispanic Americans (8.4%), 45 Asian Americans or Pacific Islanders (13.5%), two American Indians (0.6%), 19 participants of mixed ethnicity (5.7%), and eight who identified themselves as an "Other" ethnicity (2.4%). Of the total participants, 29 participants (8.7%) reported having a professionally diagnosed mental illness, while 39 individuals (11.7%) reported believing they have a mental illness. The most frequent diagnoses reported were depression (2.1%), anxiety (2.1%), and multiple comorbid diagnoses (1.2%). The majority of participants, 167 individuals (50%) were in their freshman year of college, 93 were sophomores (27.8%), 43 were juniors (12.9%), 27 were seniors (8.1%), and 4 identified as having been in college for greater than four years (1.2%).

Means, standard deviations, and ranges for the independent variables (total neuroticism score, total negative affect score, total impulsivity score, and impulsivity subscale scores) are shown in Table 1. Means, standard deviations, and ranges for the dependent addiction variables are shown in Table 2.

Table 1

Mean, Std Deviation, and Range of Independent Variables (SONA)

Variable	*M*	SD	Range
NEO-Neuroticism Total	158.12	11.81	134-193
PANAS NA Score	30.17	4.86	14-47
BIS-11 Total	64.82	10.42	42-94
BIS-11 Attentional	18.06	3.67	8-28
BIS-11 Motor	22.60	4.83	14-37
BIS-11 Nonplanning	24.16	4.55	14-37

Table 2

Mean, Std Deviation, and Range of Dependent Addiction Variables (SONA)

Variable	*M*	SD	Range
Internet	16.91	10.88	0-49
Gambling	1.47	4.03	0-25
Exercise	13.37	3.50	5-23
Gaming	1.51	2.12	0-9
Sex	2.39	2.97	0-13
Shopping	34.74	9.54	13-63
Work	39.96	9.16	17-68
Binge Eating	.61	.92	0-13
Substance Abuse	1.30	2.75	0-4

In the sample drawn from Amazon's MTurk system, there were 255 total participants including 104 males (40.8%) and 151 females (59.2%). The mean age of all participants was 34.79 (*SD* =12.61). There were 193 Caucasians (75.7%), 18 African Americans (7%), 5 Hispanic Americans (1.9%), 27 Asian Americans or Pacific Islanders (10.5%),

four American Indians (1.6%), seven participants of mixed ethnicity (2.7%), and one who identified him or herself as an "Other" ethnicity (0.4%). Of the total participants, 60 participants (23.3%) reported having a professionally diagnosed mental illness, while 60 more individuals (23.3%) believe they have a mental illness. The most frequent diagnoses reported were depression (10.5%), anxiety (3.9%), and multiple comorbid diagnoses (6.2%). Of the total sample, two individuals were in their freshman year of college (0.8%), 12 were sophomores (4.7%), 10 were juniors (3.9%), 11 were seniors (4.3%), 14 identified as having been in undergraduate college for greater than four years (5.4%), 34 were Masters students (13.3%), five were Doctoral students (1.9%), and 166 were not currently in school (65.1%).

Means, standard deviations, and ranges for the independent variables (total neuroticism score, total negative affect score, total impulsivity score, and impulsivity subscale scores) are shown in Table 3. Means, standard deviations, and ranges for the dependent addiction variables are shown in Table 4.

Table 3

Mean, Std Deviation, and Range of Independent Variables (MTurk)

Variable	*M*	SD	Range
NEO-Neuroticism Total	152.77	12.02	129-212
PANAS NA Score	27.29	5.50	10-41
BIS-11 Total	63.06	10.04	39-93
BIS-11 Attentional	16.55	4.10	8-29
BIS-11 Motor	22.65	3.98	14-36
BIS-11 Nonplanning	23.85	4.51	14-39

Table 4

Mean, Std Deviation, and Range of Dependent Addiction Variables (MTurk)

Variable	*M*	SD	Range
Internet	34.24	11.93	14-68
Gambling	2.20	10.60	0-21
Exercise	12.23	4.40	5-25
Gaming	1.72	3.54	0-8
Sex	7.0	9.90	0-15
Shopping	43.78	10.74	13-65
Work	36.98	8.70	19-66
Binge Eating	1.22	1.69	0-8
Substance Abuse	1.63	7.07	0-15

Two-tailed independent samples t-tests were also performed to compare means between the SONA and MTurk samples. Results, including effect sizes, are presented in Table 5. Notably, the MTurk sample reported greater symptoms of addiction for every category except exercise and work. These differences were statistically significant for Internet, sex, shopping, and binge eating. The greatest difference showed significantly higher scores on the Compulsive Internet Use Scale (CIUS), which may be an artifact of recruiting MTurk subjects entirely online (as opposed to through introductory psychology classes directing students to participate in the online SONA system).

Hypothesis 1: Total and subscale impulsivity scores will be positively correlated with scores on measures of behavioral addiction for each of eight behavioral addictions and substance abuse.

Initial analyses showed four addiction subscales were notably negatively skewed. A log base 10 transformation was used for substance abuse (SIP-AD), sex addiction (SAST-R), video gaming addiction (PVP), and gambling addiction (CPGI) scores to improve the shape of their distributions. This transformation enabled a better comparison

Table 5

Comparisons (t-tests) and Effect Sizes (Cohen's d) for Personality Factors and Addiction Measures by Sample

	SONA		MTurk			
Variable	*M*	*SD*	*M*	*SD*	t	*Cohen's d*
Personality Factors						
Neuroticism	158.12	11.81	152.77	12.02	5.41**	.45
Negative Affect	30.17	4.86	27.29	5.50	6.73**	.56
Impulsivity Total	64.82	10.42	63.06	10.04	2.09*	.17
Attentional Imp.	18.06	3.67	16.55	4.10	4.70**	.39
Motor Imp.	22.60	4.83	22.65	3.98	0.13	-.01
Nonplanning Imp.	24.16	4.55	23.85	4.51	0.82	.07
Addiction Measures						
Internet	16.91	0.88	34.24	11.93	18.37**	-2.71
Gambling	1.47	4.03	2.20	10.60	0.82	-.10
Exercise	13.37	3.50	12.23	4.40	3.50**	.29
Gaming	1.51	2.12	1.72	3.54	0.89	-.07
Sex	2.39	2.97	7.0	9.90	8.05**	-.72
Shopping	34.74	9.54	43.78	10.74	10.79**	-.89
Work	39.96	9.16	36.98	8.70	3.99**	.33
Binge Eating	0.61	0.92	1.22	1.69	5.60**	-.47
Substance Abuse	1.30	2.75	1.63	7.07	0.78	-.07

Note. n = 334 SONA; n = 255 MTurk. Imp. = Impulsivity.
* p<.05; ** p<.01

with the normal distribution of personality measures, and is commonly employed in addictions research literature.

Although there were a number of significant correlations between self-reported impulsivity and self-reported scores on the behavioral addictions measures, contrary to the hypothesis, not all correlations were positive. Additionally, the EDDS: Binge Module was not interpretable due to difficulties in scoring that resulted in very little variance. Results are presented in a Pearson Correlation Matrix in Tables 6 and 7.

Hypothesis 2: Negative affect and neuroticism scores will be positively correlated with scores on measures of behavioral addiction for each of eight behavioral addictions and substance abuse.

For both samples, there were small to medium significant relationships between levels of neuroticism and negative affect with measures of behavioral addiction and substance abuse. Contrary to hypothesis, not all correlations were positive. As before, the EDDS: Binge Module was not valid and thus not included in the final analyses. Results are presented in a Pearson Correlation Matrix in Tables 6 and 7.

Table 6

Pearson Correlation Matrix among Personality Scores and Addiction Measures (SONA)

	Neuroticism	NA	BIS-Total	BIS-A	BIS-M	BIS-NP
Internet Use	.15**	.22**	.20**	.27**	.12*	.12*
Gambling	-.12*	-.02	.34**	.25**	.40**	.15**
Exercise	.10	.18**	.00	-.01	.05	-.05
Gaming	.05	-.02	.19**	.22**	.19**	.07
Sex	.03	.08	.15**	.18**	.08	.11
Shopping	.07	.08	.39**	.27**	.37**	.29**
Work	.29**	.34**	-.12*	.02	-.01	-.28**
Binge Eating	n/a	n/a	n/a	n/a	n/a	n/a
Substance	-.04	.01	.32**	.28**	.31**	.17**

Note. * p<.05; ** p<.01

Hypothesis 3:Negative affect and neuroticism scores will be positively correlated with one another due to a significant overlap in the two constructs.

For both samples, there were small significant positive relationships between levels of total neuroticism and negative affect. In the SONA sample, there was a significant positive correlation between scores on the NEO-Total Neuroticism Scale and the PANAS-Negative Affect Scale ($r = .27$, $p < .001$). In the MTurk sample, there was

Table 7

Pearson Correlation Matrix among Personality Scores and Addiction Measures (MTurk)

	Neuroticism	NA	BIS-Total	BIS-A	BIS-M	BIS-NP
Internet Use	.38**	.19**	.36**	.41**	.28**	.18**
Gambling	.08	.09	.39**	.28**	.45**	.23**
Exercise	.17**	.21**	.10	.11	.21**	-.05
Gaming	.22**	.10	.31**	.30**	.27**	.17**
Sex	.21**	.25**	.30**	.25**	.27**	.19**
Shopping	.17**	.11	.38**	.28**	.36**	.27**
Work	.28**	.43**	.08	.15*	.21**	-.15**
Binge Eating	n/a	n/a	n/a	n/a	n/a	n/a
Substance	.20**	.14*	.39**	.34**	.35**	.24**

Note. * p<.05; ** p<.01

also a significant positive correlation between scores on the NEO-Total Neuroticism Scale and the PANAS-Negative Affect Scale ($r = .21$, $p < .001$). Although these correlations are statistically significant, the percent of variance they account for is not sufficiently strong to indicate that neuroticism and negative affect should be considered a single construct in practical applications.

Of note, an additional exploratory factor analysis including the neuroticism, negative affect, and impulsiveness measures did not reveal a theoretically meaningful factor structure. An exploratory factor analysis including the addiction measures confirmed that the individual items loaded together consistent with their original addiction scale. For example, exercise addiction items all loaded on the same factor, gambling addiction items loaded together, etc.

Hypothesis 4: Total and subscale impulsiveness will moderate the relationship between negative affect/neuroticism scores and scores on measures of behavioral addiction and substance use.

Regression analyses were conducted to test the hypothesis that BIS-11 total impulsiveness and subscale impulsiveness (attentional, motor, and nonplanning) would moderate the relationships between both neuroticism and negative affect with BAs and substance abuse. Detailed results are listed in Table 8. Correlations between impulsiveness and neuroticism/negative affect were sufficiently small ($r < .50$) to suggest an acceptable level of collinearity. Notably, neuroticism and impulsiveness scores were more highly correlated in the MTURK sample ($r = .15$-$.44$) than the SONA sample ($r = -.15$-$.14$). Given the mean age difference between samples, this finding may suggest a developmentally stronger relationship between these personality factors over time. Alternately, given the difference in reported or suspected psychopathology (20.4% in the SONA sample versus 47.1% in the MTurk sample), this finding may suggest a stronger relationship between neuroticism and impulsiveness in those with greater levels of mental illness.

Impulsiveness moderated four relationships between pathological gambling and neuroticism in the SONA sample. No other significant moderators were found. The interaction term between neuroticism and total impulsiveness explained a significant increase in variance in CPGI scores, $\Delta R^2 = .020$, $F(1, 330) = 20.00$, $p < .01$. With respect to impulsiveness subscales, the interaction terms between neuroticism and attentional and nonplanning impulsiveness subscales also explained significant increases in variance in

CPGI scores: neuroticism X attentional impulsiveness, $\Delta R^2 = .014$, $F(1, 330) = 12.61$, $p < .05$ and neuroticism X motor impulsiveness, $\Delta R^2 = .014$, $F(1, 330) = 27.97$, $p < .05$. This indicates the addition of total, attentional and motor impulsiveness significantly moderate the relationship between neuroticism and pathological gambling. The interaction term between negative affect and nonplanning impulsiveness also explained a significant increase in variance in CIUS scores: $\Delta R^2 = .02$, $F(1, 330) = 11.75$, $p < .05$.

Impulsiveness moderated seven relationships using the wider-demographic MTurk sample. In the last step of the regression analysis, the interaction term between neuroticism and nonplanning impulsiveness explained a significant increase in variance in CIUS scores, $\Delta R^2 = .019$, $F(1, 251) = 18.28$, $p < .05$. Thus, nonplanning impulsiveness was a significant moderator of the relationship between negative affect and Internet addiction. Nonplanning impulsiveness X negative affect and total impulsiveness X negative affect also explained significant amounts of variance in SAST scores, $\Delta R^2 = .017$, $F(1, 251) = 13.15$, $p < .05$ and $\Delta R^2 = .018$, $F(1, 251) = 16.63$, $p < .05$, respectively. Motor impulsiveness X neuroticism explained significant variance in EAI scores: $\Delta R^2 = .025$, $F(1, 251) = 6.92$, $p <.01$. An additional two moderators were found for work addiction: attentional impulsiveness X neuroticism, $\Delta R^2 = .019$, $F(1, 251) = 9.22$, $p < .05$; and attentional impulsiveness X negative affect, $\Delta R^2 = .021$, $F(1, 251) = 22.61$, $p <.05$.

Overall, the results of the moderation did not lead to a clear meaningful conclusion with respect to understanding the moderating effect of impulsivity in the relationship between neuroticism/negative affect and addiction. Alternately, the results may indicate that impulsiveness is not a strong moderator in these relationships and that other factors should be explored.

Table 8

Moderation Analyses for SONA and MTurk (Interaction Term Results)

	SONA					*MTurk*				
Model/Variables	B	SE B	β	F	ΔR^2	B	SE B	β	F	ΔR^2
Internet										
NEO x BIS Total	-.01	.01	-.10	7.63	.004	-.01	.01	-.08	20.78	.01
NEO x BIS Attentional	-.004	.01	-.02	10.28	.00	.002	.01	.01	23.52	.00
NEO x BIS Motor	-.01	.01	-.07	4.10	.004	-.01	.01	-.08	16.69	.01
NEO x BIS Nonplan.	-.002	.01	-.02	4.88	.09	-.03	.01	-.14	18.28	.02*
NA x BIS Total	.01	.01	.06	12.13	.004	.02	.01	.08	16.72	.01
NA x BIS Attentional	.02	.03	.03	14.92	.001	.06	.03	.10	20.87	.01
NA x BIS Motor	.004	.02	.01	6.97	.00	.04	.03	.08	10.08	.01
NA x BIS Nonplan.	.07	.03	.15	11.75	.02*	.01	.03	.02	7.31	.00
Gambling										
NEO x BIS Total	.00	.00	-.14	20.00	.02**	--	--	--	--	--
NEO x BIS Attentional	-.001	.00	-.12	12.61	.01*	--	--	--	--	--
NEO x BIS Motor	-.001	.00	-.12	27.97	.01*	--	--	--	--	--
NEO x BIS Nonplan.	.00	.00	.02	3.79	.00	--	--	--	--	--
NA x BIS Total	--	--	--	--	--	--	--	--	--	--
NA x BIS Attentional	--	--	--	--	--	--	--	--	--	--
NA x BIS Motor	--	--	--	--	--	--	--	--	--	--
NA x BIS Nonplan.	--	--	--	--	--	--	--	--	--	--
Exercise										
NEO x BIS Total	--	--	--	--	--	--	--	--	--	--
NEO x BIS Attentional	--	--	--	--	--	--	--	--	--	--
NEO x BIS Motor	--	--	--	--	--	.01	.004	.18	6.92	.03**
NEO x BIS Nonplan.	--	--	--	--	--	--	--	--	--	--
NA x BIS Total	--	--	--	--	--	--	--	--	--	--
NA x BIS Attentional	--	--	--	--	--	--	--	--	--	--
NA x BIS Motor	--	--	--	--	--	.01	.01	.04	7.22	.001
NA x BIS Nonplan.	--	--	--	--	--	--	--	--	--	--
Gaming										
NEO x BIS Total	--	--	--	--	--	.00	.00	-.09	10.57	.01
NEO x BIS Attentional	--	--	--	--	--	.00	.00	-.04	9.34	.10
NEO x BIS Motor	--	--	--	--	--	-.001	.00	-.15	9.75	.02
NEO x BIS Nonplan.	--	--	--	--	--	.00	.00	-.07	6.72	.01
NA x BIS Total	--	--	--	--	--	--	--	--	--	--
NA x BIS Attentional	--	--	--	--	--	--	--	--	--	--
NA x BIS Motor	--	--	--	--	--	--	--	--	--	--
NA x BIS Nonplan.	--	--	--	--	--	--	--	--	--	--
Sex										
NEO x BIS Total	--	--	--	--	--	.00	.00	-.07	9.44	.004
NEO x BIS Attentional	--	--	--	--	--	.00	.00	-.08	7.47	.01
NEO x BIS Motor	--	--	--	--	--	.00	.00	-.04	7.88	.001
NEO x BIS Nonplan.	--	--	--	--	--	-.001	.00	-.08	6.97	.01
NA x BIS Total	--	--	--	--	--	.001	.00	.14	16.63	.02*
NA x BIS Attentional	--	--	--	--	--	.002	.001	.11	12.00	.01
NA x BIS Motor	--	--	--	--	--	.001	.001	.09	12.35	.01
NA x BIS Nonplan.	--	--	--	--	--	.002	.001	.13	13.15	.02*

(table continues)

Shopping										
NEO x BIS Total	--	--	--	--	--	-.002	.004	-.03	14.13	.001
NEO x BIS Attentional	--	--	--	--	--	.001	.01	.09	7.40	.00
NEO x BIS Motor	--	--	--	--	--	.001	.01	.01	12.82	.00
NEO x BIS Nonplan.	--	--	--	--	--	-.01	.01	-.02	8.15	.001
NA x BIS Total	--	--	--	--	--	--	--	--	--	--
NA x BIS Attentional	--	--	--	--	--	--	--	--	--	--
NA x BIS Motor	--	--	--	--	--	--	--	--	--	--
NA x BIS Nonplan.	--	--	--	--	--	--	--	--	--	--
Work										
NEO x BIS Total	-.01	.004	-.06	12.87	.004	--	--	--	--	--
NEO x BIS Attentional	--	--	--	--	--	.02	.01	.15	9.22	.02*
NEO x BIS Motor	--	--	--	--	--	.02	.01	.13	9.71	.01
NEO x BIS Nonplan.	-.01	.01	-.07	18.32	.004	.002	.01	.01	11.01	.00
NA x BIS Total	.02	.01	.10	17.18	.01	--	--	--	--	--
NA x BIS Attentional	--	--	--	--	--	.06	.02	.15	22.61	.02*
NA x BIS Motor	--	--	--	--	--	.02	.02	.06	22.44	.003
NA x BIS Nonplan.	.02	.02	.05	21.51	.003	.02	.02	.05	19.78	.003
Substance Abuse										
NEO x BIS Total	--	--	--	--	--	.00	.00	-.01	14.84	.00
NEO x BIS Attentional	--	--	--	--	--	.00	.00	-.04	11.12	.001
NEO x BIS Motor	--	--	--	--	--	.00	.00	.05	12.53	.002
NEO x BIS Nonplan.	--	--	--	--	--	-.001	.00	-.09	8.63	.01
NA x BIS Total	--	--	--	--	--	.00	.00	.07	17.10	.005
NA x BIS Attentional	--	--	--	--	--	.00	.001	.02	11.68	.00
NA x BIS Motor	--	--	--	--	--	.001	.001	.08	13.68	.006
NA x BIS Nonplan.	--	--	--	--	--	.001	.001	.06	8.63	.004

*Note. * p<.05; ** p<.01*
NEO = Neuroticism; NA =Negative Affect; BIS = Impulsiveness; BIS Nonplan. = Nonplanning Impulsiveness
-- = n/s results in the first step of regression analyses

Exploratory Hypothesis 1: There will be a significant difference between addictions in the strength of relationships between total impulsivity scores (BIS-11 Total) and total scores on nine measures of behavioral addiction and substance use.

A Hotelling-Williams t-test was performed for each correlation between total impulsiveness and the eight valid scores of behavioral addiction and substance use to determine if correlations were significantly different,[1] shown in Table 9.

[1] The EDDS: Binge Module was not interpretable due to difficulties in scoring that resulted in very little variance. This resulted in eight interpretable scales that were used in all Hotelling-Williams comparisons from here forward.

The MTurk sample revealed 17 significant differences between correlations. The pattern of differences in this sample showed that relationships between impulsiveness and exercise, work, and shopping addictions tended to be significantly different from the other measures of addiction. These addictions may be better characterized by another factor, for example, compulsivity or the avoidance of difficult emotions.

Within the SONA sample, significant differences were found between 18 of the correlations. Results in this sample showed no clear or discernable pattern of differences. In fact, most measures of addiction had significantly different correlations with impulsivity when compared with one another. This may reflect an age-related difference between samples. For example, it may correspond with research indicating that impulsiveness tends to be more strongly correlated with younger age (Steinberg et al., 2008). Indeed, those in the SONA sample scored significantly higher (M=64.82, SD=10.42) on total impulsiveness than those in the MTurk sample (M=63.06, SD=10.04) such that: $t(587)=2.09$, $p < .05$. Unfortunately, age-related differences could not be tested directly in the MTurk sample due to lack of statistical power.

Exploratory Hypothesis 2: There will be a significant difference between addictions in the strength of relationships between total neuroticism scores (NEO-Neuroticism Total) and total scores on nine measures of behavioral addiction and substance use.

A Hotelling-Williams t-test was performed for each correlation between NEO-Neuroticism Total and the eight valid scores of behavioral addiction and substance use to determine if correlations were significantly different from one another. The results of these t-tests for both samples are shown in Table 10.

Table 9

Hotelling-Williams Test of Significant Differences between Impulsivity Correlations

		Scale 1- PANAS Negative Affect							
		SONA Sample				MTurk Sample			
Scale 2	Scale 3	r_{13}	r_{23}	r_{12}	t	r_{13}	r_{23}	r_{12}	t
CIUS	CPGI	.34	.27	.20	-2.21	.39	.23	.36	-0.49**
	EAI	.01	.05	.20	2.71**	.10	.18	.36	3.40**
	SIP	.32	.21	.20	-1.83	.39	.26	.36	-0.39
	CBS	.39	.34	.20	-3.22**	.38	.33	.36	-0.30
	DUWAS	-.12	.21	.20	4.79**	.08	.27	.36	3.91**
	PVP	.19	.28	.20	0.14	.31	.38	.36	0.82
	SAST	.15	.16	.20	0.76	.30	.39	.36	0.96
CPGI	EAI	.01	.10	.34	4.89**	.10	.33	.39	4.34**
	SIP	.32	.51	.34	0.35	.39	.49	.39	0.12
	CBS	.39	.16	.34	-0.80	.38	.29	.39	0.21
	DUWAS	-.12	.03	.34	6.39**	.08	.22	.39	4.29**
	PVP	.19	.47	.34	2.75**	.31	.33	.39	1.30
	SAST	.15	.16	.34	2.84**	.30	.37	.39	1.48
EAI	SIP	.32	.07	.01	-4.52**	.39	.15	.10	-3.73**
	CBS	.39	.05	.01	-5.54**	.38	.25	.10	-3.86**
	DUWAS	-.12	.24	.01	1.75	.08	.36	.10	0.30
	PVP	.19	-.08	.01	-2.43	.31	.19	.10	-2.67**
	SAST	.15	.03	.01	-1.98	.30	.18	.10	-2.53*
SIP	CBS	.39	.10	.32	-1.04	.38	.19	.39	0.10
	DUWAS	-.12	.01	.32	6.03**	.08	-.14	.39	3.45**
	PVP	.19	.29	.32	2.08	.31	.30	.39	1.17
	SAST	.15	.28	.32	2.76**	.30	.41	.39	1.42
CBS	DUWAS	-.12	.03	.39	7.26**	.08	.10	.38	3.79**
	PVP	.19	-.05	.39	2.70**	.31	.21	.38	1.01
	SAST	.15	.02	.39	3.39**	.30	.31	.38	1.21
DUWAS	PVP	.19	.01	-.12	-4.12**	.31	.17	.08	-2.91**
	SAST	.15	.04	-.12	-3.56**	.30	.28	.08	-3.00**
PVP	SAST	.15	.22	.19	0.65	.30	-.34	.31	0.09

Note. $N_{SONA} = 334$, $N_{MTURK} = 255$. Hotelling-Williams tests were carried out to test whether correlations between Scales 1 and 3 (r13) were significantly different from those between Scales 2 and 3 (r23). Tests also controlled for correlations between Scales 1 and 2 (r_{12}). CIUS = Internet CPGI = Gambling; EAI = Exercise; SIP = Substance Abuse; CBS = Shopping; DUWAS = Work; PVP = Video Gaming; SAST = Sex. ** p<.01

The MTurk sample revealed 7 significant differences between correlations. The pattern of differences in this sample showed that the relationship between Internet addiction and neuroticism tended to be significantly different from the relationship between neuroticism and most other measures of addiction, with the exception of work addiction. Additionally, the relationship between work addiction and neuroticism differed significantly from the relationship between gambling addiction and neuroticism. These results may indicate that neuroticism plays a particularly important role in Internet addiction, or to a lesser extent, work addiction.

Within the SONA sample, significant differences were found between 14 of the correlations. The pattern of differences in this sample showed that neuroticism might play a more discriminating role in Internet, gambling, and work addictions. This is generally consistent with the MTurk data, although it may be that neuroticism plays a more influential role in differentiating scores on measures of addiction in a younger population, a less pathological population, or in a population that is more likely to be highly religious. Indeed, those in the SONA sample scored significantly higher (M=158.12, SD=11.81) on total neuroticism than the MTurk sample (M=152.77, SD=12.02) such that: $t(587)=5.41$, $p < .01$. Unfortunately, these hypotheses could not be tested directly due to low statistical power or lack of demographic information on religious affiliation.

Exploratory Hypothesis 3: There will be a significant difference between addictions in the strength of relationships between negative affect scores (PANAS-Negative Affect Scale) and scores on nine measures of behavioral addiction and substance use.

Table 10

Hotelling-Williams Test of Significant Differences between Neuroticism Correlations

		Scale 1- PANAS Negative Affect							
		SONA Sample				MTurk Sample			
Scale 2	Scale 3	r_{13}	r_{23}	r_{12}	t	r_{13}	r_{23}	r_{12}	t
CIUS	CPGI	-.02	.27	.22	3.70**	.14	.23	.19	4.12**
	EAI	.18	.05	.22	0.48	.21	.18	.19	2.81**
	SIP	.01	.21	.22	3.05**	.14	.26	.19	2.58
	CBS	.08	.34	.22	2.15	.11	.33	.19	3.15**
	DUWAS	.34	.21	.22	-1.94	.43	.27	.19	1.40
	PVP	-.02	.28	.22	3.61**	.38	.38	.19	2.46
	SAST	.08	.16	.22	2.04	.39	.39	.19	2.65**
CPGI	EAI	.18	.10	-.02	-2.82**	.21	.33	.09	-1.74
	SIP	.01	.51	-.02	-0.60	.14	.49	.09	-0.80
	CBS	.08	.16	-.02	-1.50	.11	.29	.09	-0.36
	DUWAS	.34	.03	-.02	-5.04**	.43	.22	.09	-4.74**
	PVP	-.02	.47	-.02	-0.11	.38	.33	.09	-0.19
	SAST	.08	.16	-.02	-1.37	.39	.37	.09	-2.43*
EAI	SIP	.01	.07	.18	2.32	.14	.15	.21	0.92
	CBS	.08	.05	.18	1.31	.11	.25	.21	1.28
	DUWAS	.34	.24	.18	-2.51	.43	.36	.21	-3.33**
	PVP	-.02	-.08	.18	2.48	.38	.19	.21	1.40
	SAST	.08	.03	.18	1.42	.39	.18	.21	-0.56
SIP	CBS	.08	.10	.01	-0.99	.11	.19	.14	0.29
	DUWAS	.34	.01	.01	-4.53**	.43	-.14	.14	-3.34**
	PVP	-.02	.29	.01	0.41	.38	.30	.14	0.49
	SAST	.08	.28	.01	-0.97	.39	.41	.14	-1.77
CBS	DUWAS	.34	.03	.08	-3.57**	.43	.10	.11	-4.06**
	PVP	-.02	-.05	.08	1.26	.38	.21	.11	0.17
	SAST	.08	.02	.08	0.12	.39	.31	.11	-1.95
DUWAS	PVP	-.02	.01	.34	4.90**	.38	.17	.43	4.40**
	SAST	.08	.04	.34	3.70**	.39	.28	.43	2.55
PVP	SAST	.08	.22	-.02	-1.33	.39	-.34	.01	-1.53

Note. $N_{SONA} = 334$, $N_{MTURK} = 255$. Hotelling-Williams tests were carried out to test whether correlations between Scales 1 and 3 (r13) were significantly different from those between Scales 2 and 3 (r23). Tests also controlled for correlations between Scales 1 and 2 (r_{12}). CIUS = Internet CPGI = Gambling; EAI = Exercise; SIP = Substance Abuse; CBS = Shopping; DUWAS = Work; PVP = Video Gaming; SAST = Sex. ** p<.01

A Hotelling-Williams t-test was performed for each correlation between the PANAS- Negative Affect scale and the eight valid scores of behavioral addiction and substance use to determine if correlations were significantly different from one another. The results of these t-tests for both samples are shown in Table 11.

The MTurk sample revealed 8 significant differences between correlations. The pattern of differences in this sample showed that the relationship between work addiction and negative affect was significantly different from the relationship between negative affect and all other measures of addiction. Additionally, the relationship between gambling addiction and negative affect differed significantly from the relationship between sex addiction and negative affect. These results may indicate that negative affect plays a particularly important role in work addiction.

Within the SONA sample, significant differences were found between 13 of the correlations. The pattern of differences in this sample showed that negative affect might play a more discriminating role in Internet, work, and gambling addictions. This is generally consistent with the MTurk data, although it may be that negative affect plays a more influential role in differentiating scores on a greater number of measures of addiction in a younger population, a less pathological population, or in a population that is more likely to be highly religious. Indeed, those in the SONA sample scored significantly higher (M=30.17, SD=4.86) on negative affect than the MTurk sample (M=27.29, SD=5.50) such that: $t(587) = 6.73$, $p < .01$. As before, these hypotheses could not be tested directly due to low statistical power or lack of demographic information on religious affiliation. Interestingly, the pattern of differences in negative affect in the SONA sample very closely resembles the pattern of differences observed for neuroticism.

Table 11

Hotelling-Williams Test of Significant Differences between Negative Affect Correlations

		Scale 1- PANAS Negative Affect							
		SONA Sample				MTurk Sample			
Scale 2	Scale 3	r_{13}	r_{23}	r_{12}	t	r_{13}	r_{23}	r_{12}	t
CIUS	CPGI	-.12	.27	.15	4.17**	.08	.23	.38	4.12**
	EAI	.10	.05	.15	0.67	.17	.18	.38	2.81**
	SIP	-.04	.21	.15	2.77**	.20	.26	.38	2.58
	CBS	.07	.34	.15	1.20	.17	.33	.38	3.15**
	DUWAS	.21	.21	.15	-2.16	.28	.27	.38	1.40
	PVP	.28	.28	.15	1.51	.22	.38	.38	2.46
	SAST	.16	.16	.15	1.67	.21	.39	.38	2.65**
CPGI	EAI	.10	.10	-.12	-3.03**	.17	.33	.08	-1.23
	SIP	-.04	.51	-.12	-1.49	.20	.49	.08	-1.85
	CBS	.07	.16	-.12	-2.77**	.17	.29	.08	-1.14
	DUWAS	.29	.03	-.12	-5.67**	.28	.22	.08	-2.64**
	PVP	.05	.47	-.12	-3.06**	.22	.33	.08	-1.94
	SAST	.03	.16	-.12	-2.15	.21	.37	.08	-1.85
EAI	SIP	-.04	.07	.10	1.87	.20	.15	.17	-0.33
	CBS	.07	.05	.10	0.33	.17	.25	.17	0.04
	DUWAS	.29	.24	.10	-2.95**	.28	.36	.17	-1.64
	PVP	.05	-.08	.10	0.61	.22	.19	.17	-0.66
	SAST	.03	.03	.10	0.89	.21	.18	.17	-0.51
SIP	CBS	.07	.10	-.04	-1.55	.17	.19	.20	0.38
	DUWAS	.29	.01	-.04	-4.47**	.28	-.14	.20	-0.95
	PVP	.05	.29	-.04	-1.38	.22	.30	.20	-0.33
	SAST	.03	.28	-.04	-1.08	.21	.41	.20	-0.20
CBS	DUWAS	.29	.03	.07	-2.96**	.08	.10	.17	-1.43
	PVP	.05	-.05	.07	0.30	.31	.21	.17	-0.70
	SAST	.03	.02	.07	0.56	.30	.31	.17	-0.59
DUWAS	PVP	.05	.01	.29	3.24**	.31	.17	.28	0.80
	SAST	.03	.04	.29	3.55**	.30	.28	.28	1.01
PVP	SAST	.03	.22	.05	0.28	.30	-.34	.22	0.11

Note. $N_{SONA} = 334$, $N_{MTURK} = 255$. Hotelling-Williams tests were carried out to test whether correlations between Scales 1 and 3 (r13) were significantly different from those between Scales 2 and 3 (r23). Tests also controlled for correlations between Scales 1 and 2 (r_{12}). CIUS = Internet CPGI = Gambling; EAI = Exercise; SIP = Substance Abuse; CBS = Shopping; DUWAS = Work; PVP = Video Gaming; SAST = Sex. ** p<.01

This may provide further support for the overlap in these constructs for the SONA sample in particular. The same pattern was not observed as strongly in the MTurk sample.

CHAPTER FOUR

Discussion

The purpose of this study was to examine impulsivity, negative affect, and neuroticism in and across eight behavioral addictions (pathological gambling, compulsive buying/shopping, exercise, work, sex, Internet use, video gaming, and binge eating) and substance abuse. Scores on measures of behavioral addiction and substance abuse were expected to correlate positively with scores on measures of impulsivity, negative affect, and neuroticism. However, behavioral addictions and substance abuse were hypothesized to differ in the pattern of their relationships with these personality factors. These differences were expected to inform current etiological and classification questions in the field of behavioral addictions. Negative affect and neuroticism were also hypothesized to be sufficiently dissimilar to warrant examining each construct separately. Additionally, higher and lower order impulsiveness was hypothesized to moderate relationships between negative affect/neuroticism and scores on measures of BA and substance abuse.

Contrary to prediction, some scores on measures of behavioral addiction correlated negatively with the identified personality factors. Consistent with hypothesis, Hotelling-Williams tests did reveal significant differences in the strength of relationship between individual addictions and specific personality factors. Of note, the binge eating measure (EDDS) was not interpreted due to lack of variation inherent in the scoring of the measure not evident before data collection. Although not originally a target of analysis, interesting findings emerged when comparing patterns of significant

correlations in the SONA and MTurk samples. These samples differed significantly on mean age and age dispersion: SONA (*M*=19.22, *SD*= .47) and MTurk (*M*=34.79, *SD* =12.61). The samples also differed on levels of reported psychopathology (20.4% in the SONA sample versus 47.1% in the MTurk sample). Very few tests of moderation were significant, revealing few meaningful or interpretable results.

A visual depiction of the relationship between personality factors and the interpretable BAs and substance abuse is listed below in Tables 12 and 13.

Interpretation of the Relationship between Impulsiveness and Addictions

This study found both higher and lower order measures of impulsiveness were significantly correlated with scores on most, but not all, measures of addiction. Both samples demonstrated a lack of or negative relationships between work addiction and impulsiveness. The same pattern was observed in the relationship between exercise addiction and impulsiveness. Pearson *r* correlations in both these samples were in the small to medium range for effect size.

If compulsivity is dialectical to impulsivity, then these results may suggest compulsiveness plays a more substantial role in work and exercise addictions than impulsiveness. On the other hand, impulsiveness may play a larger role in Internet, gambling, gaming, sex, shopping, and substance addictions. This difference is reminiscent of the argument that BAs should be viewed along an impulsive-compulsive spectrum (Potenza, Koran, & Pallanti, 2009). Research has documented phenomenological similarities and differences when comparing BAs and compulsivity-based disorders like OCD (Potenza, Koran, & Pallanti, 2009). This study's results may

Table 12

Visual Depiction of Personality Factors in Addiction (SONA)

	Neuroticism*	Negative Affect*	Impulsivity*
Internet Use	+	+	+
Gambling	--	o	+
Exercise*	o	+	o
Gaming	o	o	+
Sex	o	o	+
Shopping	o	o	+
Work*	+	+	--
Substance	o	o	+

Note. (+) = Significant positive correlation; (--) = Significant negative correlation; (o) = Non-significant correlation; * = Significantly higher mean than MTurk sample

Table 13

Visual Depiction of Personality Factors in Addiction (MTurk)

	Neuroticism	Negative Affect	Impulsivity
Internet Use*	+	+	+
Gambling	o	o	+
Exercise	+	+	o
Gaming	+	o	+
Sex*	+	+	+
Shopping*	+	o	+
Work	+	+	o
Substance	+	+	+

Note. (+) = Significant positive correlation; (--) = Significant negative correlation; (o) = Non-significant correlation; * = Significantly higher mean than SONA sample

suggest that certain BAs, such as work and exercise addictions, are more etiologically similar to OCD.

Recent neurological studies may help elucidate reasons for the confusion in categorizing and understanding disorders characterized by impulsiveness and/or compulsiveness. First, both impulsivity and compulsivity are biologically linked to dysregulation of inhibitory control processes in the brain (Lubman, Yücel, & Pantelis, 2004). For example, both addiction and OCD neuroimaging studies show functional abnormalities in the anterior cingulate cortex (ACC), orbitofrontal cortex (OFC), and striatum, all of which are involved in regulating inhibitory control in the brain (Baxter et al., 1987; Maruff et al., 2002; Goldstein & Volkow, 2002). The functional activity of these regions is dissimilar in these two disorders (Nordahl et al. 1989; Volkow et al. 1992, 1997; Maruff et al. 2002), although both populations perform poorly on neuropsychological tasks targeting cognitive processes like response selection and inhibition (Lubman, Yücel, & Pantelis, 2004). As such, processes such as response selection (e.g. whether or not to perform a compulsion or engage in a problematic behavior) and response inhibition (e.g. resisting the urge to perform a compulsion or engage in a problematic behavior) may appear behaviorally similar in both addiction and OCD, when they are actually biologically different.

Disorders primarily characterized by symptoms of behavioral over-control tend to be viewed through the lens of compulsivity, whereas disorders primarily characterized by symptoms of behavioral under-control tend to be viewed through the lens of impulsivity. However, behavioral and substance addictions appear to contain elements of both. In substance addictions, key features include an apparent *lack of control* over substance-

seeking behaviors, for example, Miller & Gold's (1994) study of subjective reasons for relapse among drug users showed 41% attributed their relapse to "impulsive action." However, another key feature is substance use that appears *compulsive* (e.g. ritualistic, perseverative) (APA, 2000). Not surprisingly, symptoms of impulsivity and compulsivity used to define substance addictions are also typically cited in defining behavioral addictions.

Using substance addiction criteria as a guide, both compulsivity and impulsivity are important components of addictive processes, although each plays a greater or lesser role at different stages of severity. For example, research has suggested that impulsive, reward-driven behavior may facilitate one's initial substance use and abuse, whereas "addiction" is often characterized by greater compulsiveness in its later stages (Fontelle, Oostermeijer, Harrison, Pantelis, & Yücel, 2011). This progressive shift from impulsivity to compulsivity may be at the heart of the confusion in categorizing BAs and substance use disorders. The presence of both impulsivity and compulsivity in the phenomenology of these disorders may also help explain why many of these behavioral patterns are simultaneously referred to as both addiction and compulsion in common speech. For instance, the literature is replete with terms like compulsive buying *and* shopping addiction; compulsive gambling *and* gambling addiction, and so on. Not surprisingly, OCD and substance use disorders are also correlated more strongly than SUDs and non-compulsive DSM disorders (Blum et al., 2011). As such, high rates of comorbidity with OCD and other mental disorders also complicate this picture. For example, anxiety disorders (3.9% of the MTurk and 2.1% of the SONA total samples)

and depression (10.5% of the MTurk and 2.1% of the SONA total samples) were among the most reported comorbid disorders.

The results of this study suggest that work and exercise addictions may be characteristically or neurologically different than the other addictions examined. It may be the compulsiveness evident in the later stages of addiction is present in the initial or early stages of dysregulated work and exercise behaviors. For example, neuroimaging research shows that while the ACC and OFC are overactive in OCD and underactive in addiction under neutral conditions, both disorders show over-activity in these regions in the presence of provoking stimuli (e.g. an obsessive thought or addictive trigger) (Lubman, Yücel, & Pantelis, 2004). Perhaps work and exercise addictions are more similar to OCD in terms of a consistent overactivation of these regions across both neutral and symptomatic conditions. Indeed, both work and exercise addictions were once considered "positive addictions," as both behaviors in excess are more socially acceptable, and sometimes lauded. As a result, those with exercise and work addictions may be less likely to be identified as having a problem until their symptoms resemble the compulsive traits typical of other addictions. Further study of compulsiveness and brain dysfunction in BAs, particularly work and exercise, is warranted to support or refute this conclusion.

Additionally, this study's results support further exploration of motivation in understanding the possibly divergent etiologies of different BAs. Currently, researchers point to regulatory failures in the brain's reward system to help explain the biological causes of addiction (Lubman, Yücel, & Pantelis, 2004). Impulsivity then would be expected to play a major role in facilitating one's motivation to pursue rewards, as a

person high on impulsiveness would be more likely to act on this drive without slowing to consider the consequences. However, failing to regulate one's drive for reward may not be a sufficient explanation for all BAs, as suggested by the lack of impulsiveness in exercise and work addictions seen in this study. One may need to consider other motivations as well. One possibility is that those with work and exercise addictions may be initially motivated by a desire to avoid punishment (e.g. social stigma related to obesity, criticism from a demanding boss, etc.) or to avoid uncomfortable emotional states (explored later). These avoidance behaviors could be negatively reinforcing and potentially develop via mechanisms more similar to other avoidance-oriented disorders (e.g. OCD or PTSD). If this is the case, individuals with different BAs may continue to engage in problematic behavior due to positive *or* negative reinforcement in the early stages. Later, these same individuals may appear similar due to either deficits in their reward system, deficits in their inhibitory system, or both. Overall, the end stages may look very similar for addictions with very different initial motivators or reinforcement mechanisms.

If confirmed, these findings would have important implications for the classification, assessment, and treatment of these disorders. For example, those with dysregulated work or exercise behaviors may benefit from greater and more targeted assessment of compulsive patterns of thinking and behavior. Or, they may better relate to a clinician who understands their disorder as an attempt to avoid punishment, as opposed to an attempt to approach reward. Those with work or exercise addiction may also better benefit from treatments that preferentially target compulsiveness and fear exposure, such as those used in treating OCD, in addition to CBT approaches that improve response

selection and inhibition skills. Interestingly, most current treatment approaches already incorporate therapeutic techniques aimed at compensating for abnormalities in inhibitory control. Lubman, Yücel, & Pantelis (2004) point out that Motivational Interviewing targets response selection by helping patients explore the pros and cons of a behavior but also aims to improve response inhibition by teaching patients refusal skills or learning to cope with urges. Additionally, Twelve Step programs are well known for emphasizing a failure of inhibitory control by asking participants to admit they are powerless over a substance or behavior (Alcoholics Anonymous, 2001). These clinical examples support the idea that both disorders featuring impulsivity and/or compulsivity may be understood more comprehensively as resulting in part from inhibitory dysfunction.

The results of this study were also consistent with the bulk of research literature demonstrating higher levels of impulsivity in younger populations. Comparing the younger SONA sample with the older MTurk sample, both total and attentional impulsiveness scores were significantly higher in the SONA sample with small effect sizes (d= .17 and d=.39, respectively). As this was not a primary aim of the study, further analysis was not conducted. However, it is notable that the general pattern of correlations between addictions and impulsivity did not suggest a stronger relationship between impulsiveness and addiction scores for the SONA sample than the MTurk sample. Instead, correlations between impulsiveness and addiction tended to be higher in the MTurk sample, perhaps reflecting the effect of greater levels of comorbid psychopathology. This finding may alternately suggest those who remain highly impulsive into later adulthood (e.g. as a result of delayed or dysfunctional cortical maturation) may be more likely to suffer from behavioral addictions. Unfortunately,

correlations could not be reliably calculated for subsets by age or mental illness within the MTurk sample due to lack of statistical power. Longitudinal study would be required for further exploration of these hypotheses.

Interpretation of the Relationship between Neuroticism and Addictions

This study found significant correlations for neuroticism with Internet and work addiction scores in the SONA sample. In the MTurk sample, significant correlations were found between neuroticism and Internet, exercise, gaming, sex, shopping, work, and substance addictions. These findings generally support literature demonstrating high levels of neuroticism and emotional instability in substance and behavioral addictions (Hausenblas & Giacobbi Jr., 2004; Measelle, Stice, & Springer, 2006; Mehroof & Griffiths, 2010). . Pearson *r* correlations in both these samples showed small effect sizes with work addiction the most strongly related in the SONA sample ($d = .34$) and Internet addiction the most strongly related in the MTurk sample ($d = .38$). On the other hand, results showed gambling addiction scores were not significantly correlated with neuroticism or NA in the MTurk sample and significantly negatively correlated in the SONA sample, which was inconsistent with existing research (MacLaren, Fugelsang, Harrigan, & Dixon, 2011). This may suggest those with symptoms of gambling addiction were not well represented in these samples, or that those with gambling problems in these samples were not characteristic of typical pathological gamblers.

The most notable pattern in these results is the observable difference in correlations between the SONA and MTurk samples. The MTurk sample demonstrated significant relationships between neuroticism and seven addiction measures versus the two significant relationships observed in the SONA sample. The primary differences

between samples are the MTurk sample's higher mean age and higher percentage of reporting diagnosed or suspected mental illness: for age, SONA (*M*=19.22, *SD*= .47) and MTurk (*M*=34.79, *SD* =12.61); for psychopathology, 20.4% in the SONA sample versus 47.1% in the MTurk sample. Additionally, the MTurk sample scored significantly higher on measures of Internet, sex, and shopping addictions, as well as binge eating. Either differences in age or psychopathology could be hypothesized to account for portions of the difference in neuroticism between samples. For example, the correlation between neuroticism and a host of externalizing and internalizing disorders has been demonstrated repeatedly (Kotov, Gamez, Schmidt, & Watson, 2010). Contrary to this hypothesis, greater levels of neuroticism were not observed in the MTurk sample. In fact, those in the SONA sample (*M*=158.12, *SD*=11.81) scored significantly higher ($t(587) = 5.41$, $p < .01$) on total neuroticism than the MTurk sample (*M*=152.77, *SD*=12.02). This difference was between a small and medium effect size ($d = .45$).

As such, these results may better support the conclusion that neuroticism is related to addiction differently in samples with different demographics. One thought is those who were initially driven to engage in addictive behaviors for the purpose of seeking reward may, over time, be driven to engage in those same behaviors for the purpose of avoiding or temporarily regulating anxiety or emotional instability. The onset of many behavioral and substance addictions occurs in late adolescence. This is largely because late adolescence is when many are first allowed access or unrestricted access to these behaviors and substances. Those with greater levels of trait neuroticism may find engaging in addictive behaviors or substance abuse more rewarding or emotionally regulating initially than those who do not use these behaviors to regulate affect. If so,

these behaviors or substances may be more strongly reinforced, possibly contributing to continued engagement in these patterns as they age. Those with lesser neuroticism may also have already developed adaptive coping skills such that potentially addictive behaviors may not be needed for the purpose of emotional regulation and less likely to develop problematically or continue over time.

Research and a plethora of treatments suggest that addictive processes are typically unsuccessful strategies for long-term emotional regulation (Padykula & Conklin, 2010). Rather, those who use these processes to regulate affect typically develop greater affective problems when they attempt to quit, evident in the dysphoria characteristic of physical and psychological withdrawal. This unintended effect of increased emotional instability may contribute to the maintenance and progression of addiction (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). This is consistent with etiological theories positing that affective instability increases the risk for substance addiction onset (Cooper, Frone, Russell, & Mudar, 1995; Sher, 1997). The results of this study suggest that neuroticism and emotional instability may be predictive of *or* a result of symptoms of BA and substance abuse over time. However, longitudinal studies would be required to determine the direction of this relationship.

By contrast, some may engage in problematic behaviors primarily related to higher levels of impulsiveness but *not* for the purpose of regulating uncomfortable emotions. These individuals may appear behaviorally similar in many ways to those who utilize problematic behaviors to cope. However, these individuals would be expected to engage in these problematic behavioral patterns less as impulsiveness naturally declines over time (Littlefield, Sher, & Wood, 2009). Essentially, some individuals may appear to

"mature out" of problematic behaviors in a pattern similar to that observed in some substance abusers (O'Malley, 2004-2005). If so, impulsivity alone may be insufficient to maintain this behavior long-term. Further study would be required to examine this conclusion in depth.

Contrary to hypothesis, moderation analyses suggest the interaction between impulsiveness and neuroticism/NA does not clearly or consistently influence the strength or direction of the relationship between neuroticism/NA and addiction symptoms. It was originally hypothesized that those with both impulsivity and neuroticism/NA may be at greater risk for the development of BAs if they had greater inherent difficulty resisting the impulse to cope with negative emotions with addictive behaviors or substances. Instead, results may indicate that solely high impulsivity, solely negative emotionality, or both may be related to the development and maintenance of different BAs in different individuals. However, on the whole it seems those with both are *not* more clearly or consistently at risk for reporting symptoms of BA and substance abuse.

Overall, these results may have important implications for the prevention, assessment, and treatment of addictions. In terms of prevention, these results suggest that those higher on neurotic traits may be at greater risk for developing problematic relationships with substances or behaviors. If so, focusing treatment on teaching adaptive coping and emotional regulation skills could be helpful. If clinicians know to assess for neuroticism specifically in the context of behavioral addiction, they may be better able to direct their interventions toward coping (as opposed to interventions targeted at reducing impulsivity) for these patients. Learning these skills early may reduce the length or severity problematic behavioral patterns.

Interpretation of the Relationship between Negative Affect and Addictions

This study found significant correlations between negative affect and Internet, exercise and work addiction scores in the SONA sample. In the MTurk sample, significant correlations were found between NA and Internet, exercise, sex, work, and substance addictions. These results are consistent with literature showing higher levels of negative affect in those with substance abuse (Measelle, Stice, & Springer, 2006), but inconsistent with studies that show a significant relationship between pathological gambling and NA (MacLaren, Fugelsang, Harrigan, & Dixon, 2011). Pearson *r* correlations in both these samples were in the small to medium range. This correlation was highest for work addiction in both samples: SONA $r = .34$ and MTurk $r = .43$.

Negative affect and neuroticism followed a very similar pattern of correlations in both samples. Given the research literature, one would expect higher levels of NA in samples with greater psychopathology, although this was not the case in the current study. Those in the sample with lesser mean psychopathology actually scored significantly higher on levels of NA than those in the other sample: $t(587)=6.73$, $p < .01$. This difference registered a medium effect size ($d = .56$).

These results could suggest that NA and neuroticism are more similar in their relationships with addiction than either trait is similar to impulsiveness. This would be expected given the theoretical overlap between neuroticism and NA (McCrae & Costa, 1987). As such, both neuroticism and NA may function in the way explored above such that NA and neuroticism may help predict future addictive patterns *or* result from past/current addictive patterns and withdrawal *or* both. There is support in the literature indicating affective instability and NA increase risk for substance abuse onset (Cooper,

Frong, Russell, & Mudar, 1995; Sher, 1997). These results may suggest that NA is more likely related to addictive behavior early on in specific behaviors such as work, exercise, and Internet abuse. However, at time passes, there appear to be greater numbers of behaviors that become linked, and more strongly linked, with NA.

Interestingly, work and exercise were the only two behaviors significantly correlated with neuroticism and negative affect but not with impulsiveness. This may further support a conceptualization of these disorders as different from the other addictions studied. As OCD is characterized by behaviors aimed at reducing mental discomfort from the outset (APA, 2000), this finding may lend credence to a shared etiological process between OCD and work and exercise addictions. Again, such a conclusion could have important implications for the prevention, assessment, and treatment of these disorders.

Comparison of Personality Factors Within and Across Addictions

Internet

Internet addiction (IA) is particularly difficult to distinguish from other BAs given many use the Internet to engage in other addictive behaviors (e.g. accessing pornography, online shopping, online video gaming, online gambling, etc.). This may help to account for this study's finding that scores on the Compulsive Internet Use Scale (CIUS) were significantly correlated with neuroticism, negative affect, and higher and lower order measures of impulsiveness in both samples. This was the only addiction with this pattern. It may be that participants had difficulty distinguishing other addictive behaviors from a purer measure of IA such that scores on this measure represent or that those with

Internet addiction symptoms are a more heterogeneous group psychologically. The MTurk sample reported significantly greater symptoms of IA than the SONA sample: $t(587)=18.37$, $p < .01$, $d = 2.71$. This is not surprising given the MTurk sample was recruited entirely through online means and may overly represent those with IA symptoms. Despite this possibility, the majority of correlations in the SONA and MTurk samples were surprisingly similar despite the large difference in their mean IA scores: SONA (M=16.91, SD=10.88); MTurk (M=34.24, SD=11.93).

Results of Hotelling-Williams correlation comparisons showed that neuroticism could be the most important factor in helping distinguish IA from other addictions. This was true of the MTurk sample especially as IA was correlated with neuroticism significantly differently that gambling, exercise, substance abuse, shopping, gaming, and sex addictions. Impulsiveness was also correlated differently with IA compared with exercise and work addictions in both samples, consistent with ideas explored previously. Results were unclear with respect to negative affect. These results are consistent with literature showing higher levels of impulsivity in those with IA (Di Nicola et al., 2010; Te Wildt, Putzig, Vukiveciv, & Wedegärtner, 2011). They also correspond with limited research linking neuroticism with IA (Tsai et al., 2009) and negative affect (Cheung & Wong, 2011). However, due to the potential for addiction overlap, these hypotheses should be interpreted with caution.

Gambling

This study showed significant correlations between gambling and impulsiveness, consistent with the research literature (Bagby et al., 2007; MacLaren, Fugelsang, Harrigan, & Dixon, 2011; Nordin & Nylander, 2007; Parke, Griffiths, & Irwing, 2004;

Reid et al., 2011). This finding was observed in both samples and showed similar patterns across impulsiveness subscales. In both samples, motor impulsiveness was the most strongly correlated with scores on the Canadian Pathological Gambling Index (CPGI): SONA $r = .40$, $p < .01$ and MTurk $r = .45$, $p < .01$. These were among the strongest correlations observed when examining all personality factor-addiction correlations, lending further support for the role of impulsiveness in PG. Hotelling-Williams correlation comparisons also indicated a role for impulsiveness in helping to distinguish PG from other addictions. In the SONA sample, the relationship between total impulsivity and PG scores was significantly different than total impulsivity and scores on measures of exercise, work, gaming, sex, and Internet addictions. The MTurk sample showed the relationship between total impulsivity and PG was different than between total impulsivity and scores on measures of exercise and work addictions. Surprisingly, scores on the CPGI were not significantly different when comparing the two samples. This may indicate that high impulsiveness is a particularly important factor in distinguishing PG in samples depending on demographic features. Hotelling-Williams correlations should be interpreted with caution due to the likelihood other addictions may have been lesser developed in the younger sample due to differences in age of onset or severity. If true, one would expect impulsiveness would be more strongly correlated with any BA with scores in a younger sample at the same level of occurrence or severity as in older samples.

Surprisingly, this study did not find significant positive correlations between neuroticism or NA and scores on the CPGI. In fact, neuroticism was significantly negatively correlated with PG in the SONA sample. This is inconsistent with a recent

meta-analysis by Mac Laren, Fugelsang, Harrigan, & Dixon (2011) showing a medium effect size for NA in pathological gamblers. Mac Laren, Best, Harrigan, & Dixon (2011) also found small, but significant positive correlations between neuroticism and PG in a university sample. Neither sample supported this conclusion. This study's results may be indicative of a non-representative sample or an underrepresentation of those with symptoms of PG. Alternately, these results may support the conclusion that impulsiveness is generally a more valuable factor than neuroticism or NA when assessing or treating those with PG.

Exercise

The Exercise Addiction Inventory (EAI) demonstrated significant correlations with neuroticism in the MTurk sample and both neuroticism and negative affect in the SONA sample. This finding is consistent with extant literature showing neuroticism was predictive of EA in a college sample (Hausenblas & Giacobbi Jr., 2004). This may also be related to symptom overlap between EA and eating disorders. For example, exercise is often used as a compensatory mechanism for bingeing in bulimia nervosa or in addition to restricting behaviors in anorexia nervosa (APA, 2000). Hotelling-Williams correlations showed the relationship between negative affect and EA scores was significantly different than substance abuse, work, and gaming addictions in the SONA sample and work addiction in the MTurk sample. This may indicate that NA plays a more important role in distinguishing EA from other addictions in a younger or less pathological sample. However, due to a lack of statistical power this could not be examined directly. There was a significant difference between samples, with the younger sample reporting higher total scores: $t(587)=3.50$, $p < .01$, $d=.29$. This may be related to

age effects considering older participants may be less able to exercise for a variety of reasons including physical capacity. Interestingly, while correlations between NA and EA were different than between NA and work addiction, EA appeared more similar to work addiction in its overall pattern (e.g., significant relationships with neuroticism and NA in the absence of significant relationships with impulsivity). This may point to a difference in severity or suggest that neuroticism and NA play a lesser role in EA than in work addiction, but a greater role in EA and work addiction than in other BAs.

Unlike other addictions, EA was not significantly associated with impulsiveness, with the exception of motor impulsiveness in the MTurk sample. This is inconsistent with findings in a sample of patients with bipolar disorder and EA that found significant relationships with EA (Di Nicola et al., 2010). However, it is possible that impulsiveness plays a significant role in bipolar disorder and not in EA. No other studies examining EA and impulsiveness were found. Hotelling-Williams correlations showed the correlation between EA and total impulsivity was significantly different than between total impulsivity and the majority of other addictions. Results of this study suggest EA is characterized by a lack of impulsiveness. As explored previously, EA may be characterized more accurately by the presence of compulsivity, although targeted research is required to examine this hypothesis.

Gaming

Results indicated there was no significant difference between samples with respect to scores on the Problem Video Game Playing Scale (PVP). Scores were significantly correlated with total and subscale impulsivity in both samples with the strongest correlation ($r = .31$, $p < .01$) for total impulsiveness in the MTurk sample. This

finding was consistent with research showing higher levels of impulsivity in those with gaming addiction (te Wildt, Putzig, Vukicevic, & Wedegärtner, 2011). Hotelling-Williams correlations also suggested that relationships between total impulsivity and PVP scores were significantly different than correlations between total impulsivity and many other addictions (gambling, exercise, substance abuse, shopping, and work) in the SONA sample. In general, impulsivity was less strongly correlated with gaming than with other addictions, except for exercise and work. In the MTurk sample, this relationship only differentiated video gaming addiction from exercise and work addictions, suggesting that impulsiveness plays a part in defining problem video gaming but no more than most other BAs.

Results showed a small significant correlation (r =.22, $p < .01$) between PVP scores and neuroticism in the MTurk sample only. Negative affect was not significantly correlated with PVP scores in either sample. The few studies examining these factors in problem gamers have previously suggested a significant relationship between gaming, neuroticism, and NA (Chen, 2008; Mehroof & Griffiths, 2010) that was not fully supported by this study. Similarly, Hotelling-Williams correlations did not suggest a strong role for neuroticism or NA in differentiating BAs from one another or substance abuse. However, that neuroticism was a significant factor in the older, more pathological sample is notable and worth investigation in future studies.

Sex

There was a significant difference between samples in scores on the Sexual Addiction Screening Test- Revised (SAST-R) with participants in the MTurk sample scoring significantly higher than the SONA sample: $t(587)=8.05$, $p < .01$, d=.72. This is

likely related to the demographics of the SONA sample. For example, this sample was drawn from a private religious college with conservative views of sexual behavior (e.g., no sexual intercourse before marriage), and the sample was largely young and unmarried. That said, the SONA sample registered small, significant correlations between total and attentional impulsiveness and SAST-R scores: $r = .15$, $p < .01$ and $r = .18$, $p < .01$. The MTurk data may represent a broader sample with greater personal exposure to sexual behavior and, not surprisingly, produced different results. Total impulsivity and all three impulsivity subscales were more strongly correlated with SAST-R scores than in the SONA sample: total impulsiveness ($r = .30$, $p < .01$); attentional impulsiveness ($r = .25$, $p < .01$); motor impulsiveness ($r = .27$, $p < .01$); and nonplanning impulsiveness ($r = .19$, $p < .01$). These results are in line with existing research linking sex addiction and impulsivity (Kafka, 2010).

Correlations between neuroticism/NA and SAST-R scores were consistent with the pattern described previously. In the SONA sample, neither was significantly correlated. In the MTurk sample, both neuroticism ($r = .21$, $p < .01$) and negative affect ($r = .25$, $p < .01$) were small, but significantly correlated with sexual addiction scores. Previous research has linked neuroticism and shame (an aspect of NA) to hypersexual behavior in men (Reid, Stein, & Carpenter, 2011). Others have examined the role of shame in sexual addiction and proposed that shame and negative affect play a major role in treatment (Adams & Robinson, 2001).

Hotelling-Williams correlations did not indicate that impulsivity, neuroticism, or NA were clearly meaningful in helping to distinguish addictions from one another in the MTurk sample. In the SONA sample, the relationship between total impulsiveness and

SAST-R scores was significantly different than the relationship between total impulsiveness and gambling, work, shopping, and substance addiction scores. However, as discussed before, demographic effects with respect to sexual behavior in this sample may suggest these relationships are less representative of those with sex addiction symptoms. Thus, these findings should be considered with caution.

Shopping

There was a significant difference between samples with respect to mean scores on the Compulsive Buying Scale (CBS), with participants in the MTurk sample scoring higher than SONA participants: $t(587)=10.79$, $p < .01$, $d=.89$. This may be related to differences in age. As all of the participants in the SONA sample were college students and less likely to hold full-time jobs, they may have lesser access to financial resources needed to facilitate excessive shopping behavior. However, this factor was not directly assessed. Despite this difference, both samples produced significant positive correlations with total and subscale impulsivity. The highest correlations were between total impulsivity and CBS scores: MTurk ($r=.38$, $p < .01$) and SONA ($r=.39$, $p < .01$). This finding is consistent with research literature linking higher total impulsiveness scores and lower levels of effortful control in those diagnosed with compulsive buying (Claes, Bijttebier, Mitchell, Zwaan, & Mueller, 2011; Lejoyeux, Tassain, Solomon, & Adès, 1997). Hotelling-Williams correlations also suggest that the relationship between CB and impulsivity is important in helping to distinguish this BA from others, which generally produced lower correlations with impulsiveness. However, this effect largely disappears when examining the MTurk sample. In this case, impulsiveness only helped differentiate CB from work and exercise addictions.

Compulsive buying scores showed a small but significant correlation with neuroticism ($r = .17$, $p < .01$) in the MTurk sample only. Neither sample produced significant correlations with NA. This is similar to the pattern observed in gaming, sex, and substance addictions in which correlations with neuroticism and/or NA were only observed in the MTurk sample. In this case, age or levels of psychopathology may account for the difference. High neuroticism has been linked with compulsive buying in past studies. In a 2010 study by Mueller et al., those with high neuroticism and low levels of the other Big Five personality traits had more severe symptoms of CB, lesser control over symptoms, and were more anxious, sensitive interpersonally, and impulsive. Another study by Mueller and colleagues linked CB with greater levels of depression, a factor likely related to negative affect (Meuller et al., 2010). Surprisingly, NA was not significantly linked to CBS scores. The low base rate of CB, and all of the other BAs, may have affected this result if too few participants with symptoms of CB completed the survey.

Work

Given the differences in age between samples, those in the SONA sample were asked to consider homework or schoolwork within the realm of "work" to better capture their likely experience of work addiction (WA). Surprisingly, those in the SONA sample scored significantly higher on the Dutch Work Addiction Scale (DUWAS) than those in the MTurk sample: $t(587)=3.99$, $p < .01$. The difference was small in effect (d=.33). The difference may also be related to possible joblessness in the MTurk sample, which was not originally addressed.

Work addiction appeared most similar to exercise addiction with respect to its pattern of relationships with the personality factors studied. As explored above, WA in these samples appears to be related more strongly with neuroticism/NA and less correlated or negatively correlated with impulsiveness. For example, DUWAS scores were significantly negatively correlated with total impulsivity in the SONA sample (r = -.12, $p < .05$) and not significantly related in the MTurk sample. The strongest of these negative correlations was for nonplanning impulsiveness, with r = -.28, $p < .01$ in the SONA sample and r = -.15, $p < .01$ in the MTurk sample. This is consistent theoretically as nonplanning impulsiveness targets careful thinking, planning, and enjoyment of challenging mental tasks. As most with WA would be expected to use careful thinking and planning in order to complete typical work tasks, impulsiveness in this area would be detrimental. Also, those with WA would be expected to find some enjoyment in challenging mental tasks if they choose to work as a coping strategy for managing uncomfortable emotions. These findings again suggest that WA may be more related to exercise addiction and other disorders with greater compulsive than impulsive elements. This is consistent with a related study that failed to find a relationship between impulsivity and those with both WA and bipolar disorder, whereas that relationship was significant in those with other BAs and bipolar disorder (Di Nicola et al., 2010).

Both neuroticism and NA were significantly correlated with scores on the DUWAS. Neuroticism correlations were in the small range: SONA (r =.29, p < .01) and MTurk (r =.28, p < .01). Negative affect correlations were higher, approaching the medium range: SONA (r =.34, p < .01) and MTurk (r =.43, p < .01). This finding is consistent with prior studies linking neuroticism with a feeling of being driven to work

(Burke, Matthiesen, & Pallesen, 2006), and negative affect with workaholism above and beyond neuroticism (Clark, Lelchook, & Taylor, 2010).

Not surprisingly, Hotelling-Williams correlations showed that impulsiveness, neuroticism, and NA were helpful in differentiating WA from other BAs except exercise addiction. As with exercise addiction, it may be those with WA work excessively in order to manage or avoid the experience of negative emotions. Additionally, WA would likely be a more inherently attractive addiction than other BAs if one has a natural tendency toward perfectionism or compulsivity. This is because the typical acts associated with WA would be disrupted by excessive impulsiveness. If this pattern is replicated in future comparative studies in behavioral addictions, it would have important implications for creating treatment strategies that are more targeted toward coping with negative emotions and managing compulsive behavior at early and late stages of the disorder.

Substance Abuse

Scores on the Short Inventory of Problems- Alcohol and Drugs (SIP-AD) were not significantly different between samples. However, relationships between SIP-AD scores and some personality measures did differ between samples. Significant correlations were found between neuroticism and NA in only the MTurk sample, consistent with a number of other addictions (e.g., gaming, sex, shopping). This may provide further support for the hypothesis that neuroticism and NA are more strongly related to behavioral and substance addiction in older age. However, it is unclear whether or not these traits were present either before the development of addictive symptoms, or exacerbated as a result of addictive symptoms. This finding may also

suggest that *some* BAs are especially similar to substance abuse in terms of personality correlates. Such results could also support similar etiological pathways for these particular addictions, or the formation of a broader classification of addictions based on these characteristics.

In both samples, SIP-AD scores produced small to medium significant positive correlations with total impulsiveness (SONA: r =.32, $p < .01$; MTurk: r =.39). The same was true of all BIS-11 subscales. Hotelling-Williams analysis suggest that impulsivity plays a stronger role in differentiating substance abuse from addictive behaviors in the SONA sample, while in the MTurk sample it only helped differentiate substance abuse from work and exercise addictions. Clearly, impulsiveness plays a strong role in substance abuse in this study, which is consistent with prior research.

For example, Ersche, Turton, Padhan, Bullmore, & Robbins (2010) compared trait impulsivity in drug abusers, their non-drug abusing siblings, and non-drug abusing controls. They found both stimulant dependent subjects and their non-dependent siblings reported significantly higher trait impulsivity than controls suggesting impulsivity may be an endophenotype for drug addiction. Biological studies using rats have also reported that impulsivity predicts vulnerability for cocaine addiction, distinct from other vulnerabilities like anxiety (Molander et al., 2011). These studies support the role of trait impulsivity, as opposed to disinhibition related to intoxication, in the etiology of substance addiction. This study's results suggest the importance of trait impulsivity may be characteristic of most behavioral addictions, with the exception of work and exercise addictions that appear more similar to compulsivity-based disorders.

Scores on the SIP-AD produced small, but significant correlations with neuroticism (r =.20, $p < .01$) and NA (r =.14, $p < .05$) in the MTurk sample. This finding is consistent with the bulk of research showing links between negative emotionality and substance abuse. For example, Tuliao and Liwag (2011) showed NA predicted relapse on methamphetamines for a group of 51 males in recovery. Another study examined the role of neuroticism on the development of alcoholism in a sample of young adults from alcoholic families (Loukas, Krull, Chassin, and Carle, 2000). They found that neuroticism mediated this relationship and higher neuroticism predicted stronger coping motives to use alcohol. Measelle, Stice, and Springer (2006) similarly showed that initial negative emotionality, and not depressive symptoms, predicted substance abuse onset irrespective of parental support in a sample of adolescent girls. These studies may support this study's finding that negative affect and neuroticism have an important relationship with substance abuse. However, this study showed these factors play a greater role in certain samples, which may be related to demographic factors. Further, more targeted studies would be needed to help explicate this finding.

Limitations

This study had several limitations. First, the base rate for behavioral addictions is very low in the general population, usually less than 10%. As a result, using samples drawn from a general population results in relatively few subjects with clinical-level symptoms of behavioral addiction. Unfortunately, locating high numbers of participants with clinically significant symptoms for all the BAs in this study would have been extremely difficult and impractical. Doing so is also complicated by the lack of consistent or universally recognized diagnostic criteria for many of these disorders. As a

result, both the SONA and MTurk samples consist of a majority of participants with no or low-levels of BA and substance abuse symptoms. Additionally, the samples cannot be reliably separated into clinical and non-clinical groups due to the lack of diagnostic cutoff scores for the majority of BA measures. Again, this is due to the nonexistence of a clear system of categorization or diagnostic criteria for these disorders.

The SONA sample also contains a possible limitation. The sample was drawn from college students attending a Baptist university reporting a majority of students belong to a Christian faith (http://www.baylor.edu/irt/index.php?id=75614). This is an important factor considering many of these behaviors, such as premarital sex or drug or alcohol use, are discouraged by this faith system and/or punishable through the university if a student is caught. Either of these reasons may have contributed to underreporting on behalf of SONA participants. Alternately, this subset of the general population is not representative of a broad, general population, which may have skewed the data. Additionally, the SONA sample consisted of a limited age range. This also contributed to a non-representative sample of the general population and of the subset of people with BAs or substance abuse.

Potential joblessness in the MTurk sample was not assessed, which may have impacted scores on work addiction. This would need correction in further studies examining work addiction.

Additionally, this study was not originally designed with the intention of comparing the SONA and MTurk samples. As such, the research design was not tailored for that purpose. Instead, data was drawn from two sources to increase the likelihood of achieving a large enough overall sample for statistical analysis. However, demographic

differences between the samples suggested they not be combined. These samples were compared in the final analysis when exploratory analyses suggested this comparison might be consistent with prior research in addictions. However, these comparisons should be considered cautiously due to limitations in the original research design.

Future Directions

As explored above, future studies would generally benefit from more representative sampling, targeted sampling of those with symptoms of BA, and research designs targeted at measuring differences in behavioral addictions across various age groups.

More specifically, this study suggests the relationship between neuroticism/negative affect and symptoms of behavioral addiction may change over time. It may be that neuroticism/NA are more predictive of behavioral and substance addiction as one ages, or alternately, that these personality factors are accentuated as a result of common consequences of addiction (e.g. financial, relationship, or health problems). Future studies may take a longitudinal approach, tracking neuroticism/NA and symptoms of addiction in adolescents through middle and late adulthood. This study also suggested that positive reinforcement may play a stronger role in the development of addiction (presumably earlier in life) and negative reinforcement might play a greater role in the maintenance of addiction (presumably later in life). Future studies may examine motivation for initial and continued engagement in addictive behaviors. For example, researchers may examine whether initial engagement in addictive patterns in gambling or sex are motivated by a desire for reward, as opposed to a desire to escape uncomfortable emotions. It is likely that multiple pathways and personality factors interact so as to

increase the likelihood one will develop addictive patterns of behavior. Perhaps positive and negative reinforcement are more specifically linked with different clusters of personality characteristics. Such research could help clinicians better individualize and target treatment toward underlying motivational and coping processes related to each disorder and each individual's unique personality.

Future research is also needed to improve the measurement of behavioral addictions. This is complicated by the fact that many of the disorders in this study are not specifically recognized in the DSM-IV. Rather, many of these disorders would be diagnosed in a nonspecific category: Impulse Control Disorders- Not Otherwise Specified. As such, specific and valid diagnostic criteria have not been established for the majority of these disorders, making assessment and diagnosis problematic. The lack of validated cutoff scores in many of the assessment tools utilized in this study is a reflection of this problem. Future research may consider the development of a single assessment tool targeting a host of behavioral addictions along criteria accepted by the majority of professionals in those fields. The development of a singular, standardized assessment could allow researchers to conduct studies capable of being directly compared with one another. Additionally, such a tool would allow clinicians to more easily screen and assess clients for a range of addictive patterns. This is important given these disorders tend to be highly comorbid with other more common disorders, although they may not be part of standard mental illness screenings in the same way as substance addictions.

This study found that some, but not all, addictions were related to impulsiveness. Future research could examine the role of compulsivity more exclusively, or in

combination with measures of impulsivity. Additionally, future neuroimaging studies may examine the ways in which behavioral addictions relate to other disorders with respect to regions of the brain implicated in inhibitory control. This study's results suggest some BAs may be more similar to compulsivity-based disorders, such as OCD. These may include exercise addiction and work addiction. Alternately, the other addictions studied may be more neurologically similar to impulsivity-based disorders, such as substance addiction. In addition to neuroimaging techniques, neuropsychological approaches may also enhance our understanding of how these disorders compare with regard to behavioral inhibition. Such research may inform a more biologically accurate categorization of behavioral addictions in the context of other presumably related disorders, such as substance addiction and OCD. Additionally, clinicians may be able to develop more effective treatments for behavioral addictions with a better understanding of how these disorder relate to the continuum of behavioral control.

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